Diesel Power

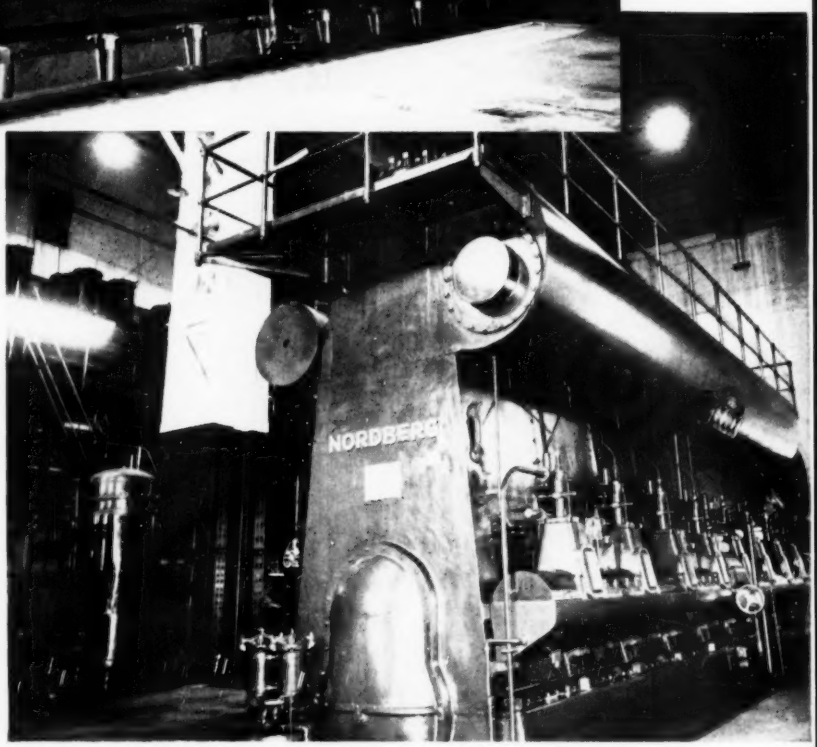
& Diesel Transportation

Our 29th Year

APRIL, 1951

BERMUDA

This latest Bermuda installation -- a 10-cylinder, 4,250 h.p. Nordberg Diesel -- adds 3,000 kw. to the Bermuda Electric Light Company's generating capacity. Engine is lubricated with Texaco in both crankcase and cylinders.



Original Nordberg engine installed in 1939 in Bermuda Electric Light Company's plant at Pembroke, Bermuda. This is an 8-cylinder, 2-cycle, 3,180 h.p. engine, which has given satisfactory and economical service. It is Texaco-lubricated.

TUNE IN . . .
TEXACO STAR THEATER
starring MILTON BERLE
on television
every Tuesday night.
See newspaper for
time and station.

TEXACO
REG'T M.

TEXACO

DIESEL POWER and DIESEL TRANSPORTATION for April, 1951, Vol. XXIX, No. 4. It is published monthly by Diesel Publications, Inc., Orange, Conn. Executive and Editorial offices 192 Lexington Ave., New York 16, N. Y. Subscription rates: United States, $3.00 per year, single copies 35¢; Canada $4.00; Foreign $5.00 per year. Entered as second class matter April 29, 1949 at the Post Office, Orange Connecticut, under Act of March 3, 1879.

DIESELS RUN CLEAN

Bermuda Electric Light Company's two Nordbergs are lubricated with TEXACO URSA OILS

When Bermuda's new 4,250 h.p. Nordberg Diesel went on the line in August, 1950, there was no question about what lubricating oil to use. *Texaco Ursa Oils* were the inevitable choice because of their outstanding performance in the original 3,180 h.p. Nordberg installation, made some years previous.

Today, *Texaco Ursa Oils* are on the job in both these great engines . . . keeping them clean . . . assuring low maintenance costs and economical operation.

Texaco Ursa Oils stand up under heat and pressure . . . maintain their extra-high resistance to oxidation throughout an extra-long service life. They keep engines free of harmful carbon and sludge . . . assuring proper valve action, open ports, free rings for proper compression and combustion. *Texaco Ursa Oils* protect modern alloy-type bearings against corrosion, guard moving parts against wear.

You can get *Texaco Ursa Oils* in the right viscosities for every type and size of Diesel, gas or dual-fuel engine. Leading engine builders approve them and operators' preference has made them America's favorites. For example, in the Diesel field alone –

More stationary Diesel horsepower in the U. S. is lubricated with Texaco Ursa Oils than with any other brand.

Keep *your* engines clean; keep *your* costs low. A Texaco Lubrication Engineer will gladly help you. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

URSA OILS FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

If you manufacture:

Combines
Compressors
Concrete Mixers
Conveyors
Cranes
Crushers
Farm Machinery
Generators
Hammer Mills
Hoists
Marine Auxiliary Units
Mining Equipment
Pumps
Refrigeration Equipment
Road Rollers

PETTER DIESELS *will cut your costs and give you proved, dependable power!*

MODEL AV2 — 4-cycle, 12 hp, 2-cylinder, 1800 rpm, vertical, water-cooled industrial diesel engine.

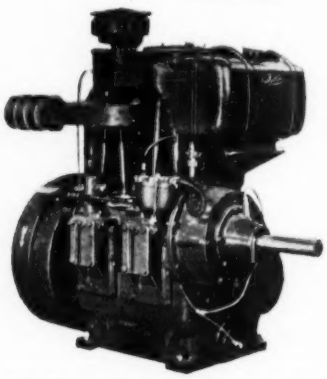
PETTER *WATER-COOLED* DIESEL ENGINES. Available in two basic 4-cycle models. Series AV-3 to 12 hp. Series B-12 to 36 hp. Thermo-syphon tank cooling or radiator. Hand or electric starting without difficulty, even under sub-zero conditions.

Type	HP Cont.	RPM	BORE In.	STROKE In.	LENGTH In.	WIDTH In.	HEIGHT* In.	WEIGHT Lbs.
AV1	3/6	1000-1800	3.15	4.33	29.75	20.375	36.625	406
AV2	6/12	1000-1800	3.15	4.33	36.5	20.625	36.625	598
B2T	12/18	1000-1500	4.33	4.33	33	24	41.375	1198
B3T	18/27	1000-1500	4.33	4.33	39.125	24	41.75	1477
B4T	24/36	1000-1500	4.33	4.33	45.75	24	41.25	1737

*With radiator

PETTER *AIR-COOLED* DIESEL ENGINES. Series AVA—3 to 10.5 hp in one and two-cylinder models. Air-cooled by flywheel fan and ducting over finned cylinders and cylinder heads. Light weight, low overall dimensions. Hand or electric starting. Full-speed drive from either end, or half-speed drive from timing-gear end. Totally enclosed, but easily accessible. Dependable operation under any climatic conditions. Direct injection with an open combustion chamber insures easy starting.

Type	HP Cont.	RPM	BORE In.	STROKE In.	LENGTH In.	WIDTH In.	HEIGHT In.	WEIGHT Lbs.
AVA1	3/5.25	1000-1800	3.15	4.33	29.75	21	30.125	390
AVA2	6/10.5	1000-1800	3.15	4.33	36.5	21	31.75	558



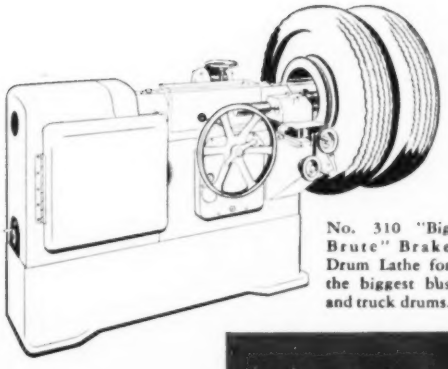
MODEL AVA2—4-cycle, 10.5 hp. 2-cylinder 1800 rpm, vertical, air-cooled industrial diesel engine.

ABOE, Inc.
Empire State Building
350 Fifth Avenue
New York 1, N. Y.

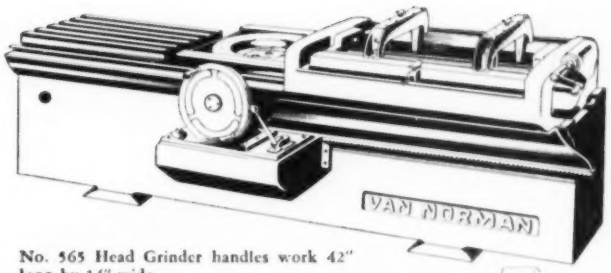
1500 Petter Diesel Engines are produced each week . . . and stocks are held throughout the U.S.A.

Petter parts and service are available in over 100 countries . . . to service your equipment abroad.

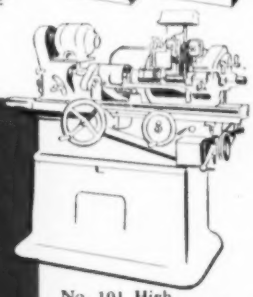
Write us today for full facts as to why Petter Diesels will cut your costs and give your equipment proved, dependable power.



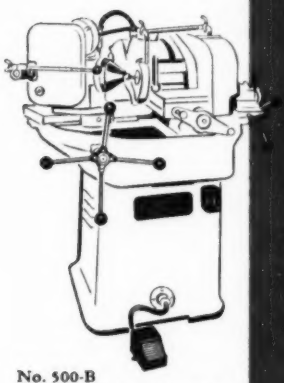
No. 310 "Big Brute" Brake Drum Lathe for the biggest bus and truck drums.



No. 565 Head Grinder handles work 42" long by 14" wide.



VAN NORMAN

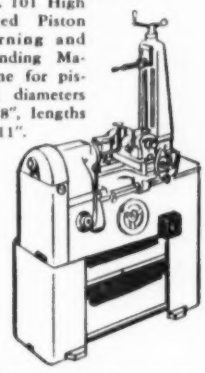


No. 500-B Heavy-Duty Valve Regrinder for valves from 15/64" to 1".

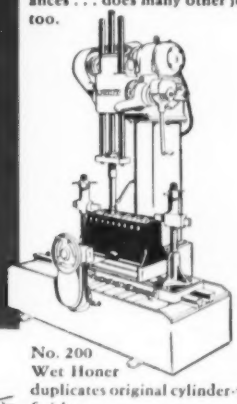
World's Most Complete Line of QUALITY, HEAVY-DUTY Reconditioning Equipment

VAN NORMAN is the name that means *"value received"* in heavy-duty reconditioning machinery. All VN Machines are designed by engineers who work directly with the engineers of the leading diesel and gas engine manufacturers and car, bus and truck builders. And all VN machines are built in one of the world's foremost precision machine-tool plants. That's why . . . from engines to brakes . . . when you buy Van Norman, you can expect the proper machine to do the job right the *first time.* For further information write:

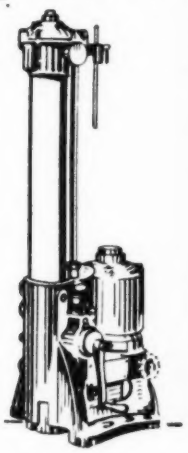
VAN NORMAN COMPANY
SPRINGFIELD 7, MASS.



No. 101 High Speed Piston Turning and Grinding Machine for piston diameters to 8", lengths to 11".

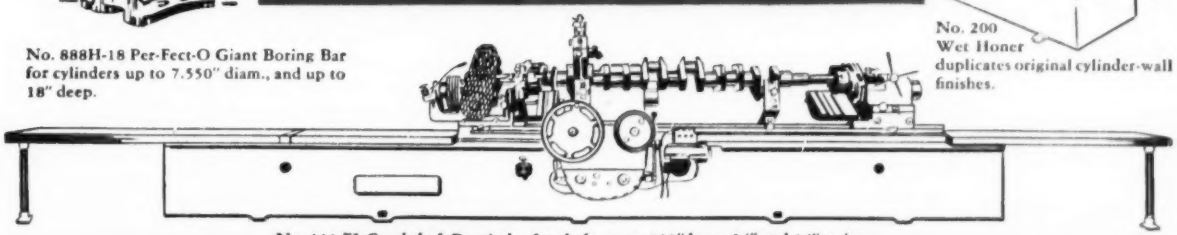


No. 232 "Pin Shop" precision-fits piston pins to factory-tolerances . . . does many other jobs, too.



No. 888H-18 Per-Fect-O Giant Boring Bar for cylinders up to 7.550" diam., and up to 18" deep.

No. 200 Wet Honer duplicates original cylinder-wall finishes.



No. 111-EL Crankshaft Regrinder for shafts up to 130" long, 24" and 34" swing.

The Best-Equipped Shop Gets the Business! that's why *"It Pays to Van Normanize"*

Announcing

4 NEW G-E TRI-CLAD SYNCHRONOUS GENERATORS

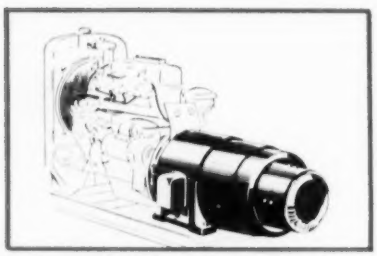
REG. U.S. PAT. OFF.

RATINGS—1.875 TO 50 KVA

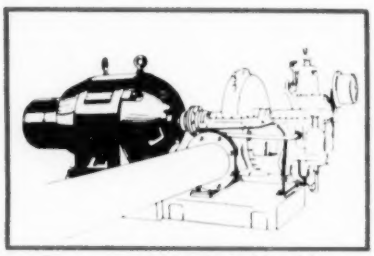
FREQUENCIES—60 AND 400 CYCLES

Four Basic Designs to Choose From—to "custom-fit" the generator to YOUR job

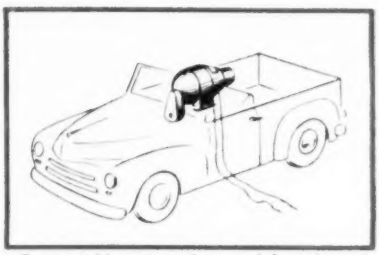
- **Externally regulated 4-pole**
- **Self-regulated 4-pole**
- **Packaged regulated 4-pole**
- **High-frequency 14-pole**



For gasoline, diesel, or gas-engine drive



For steam or hydraulic turbine drive



For portable units, other special equipment

Here's why these new generators are your best power buy—

DEPENDABLE, EFFICIENT—including Tri-Clad's famous "triple protection".

EASY TO INSTALL—space-saving Tri-Clad design makes installation easy.

FLEXIBLE—lightweight construction is well suited to portable installations.

EASY TO MAINTAIN—Tri-Clad lubrication system makes relubrication easy, but seldom needed.

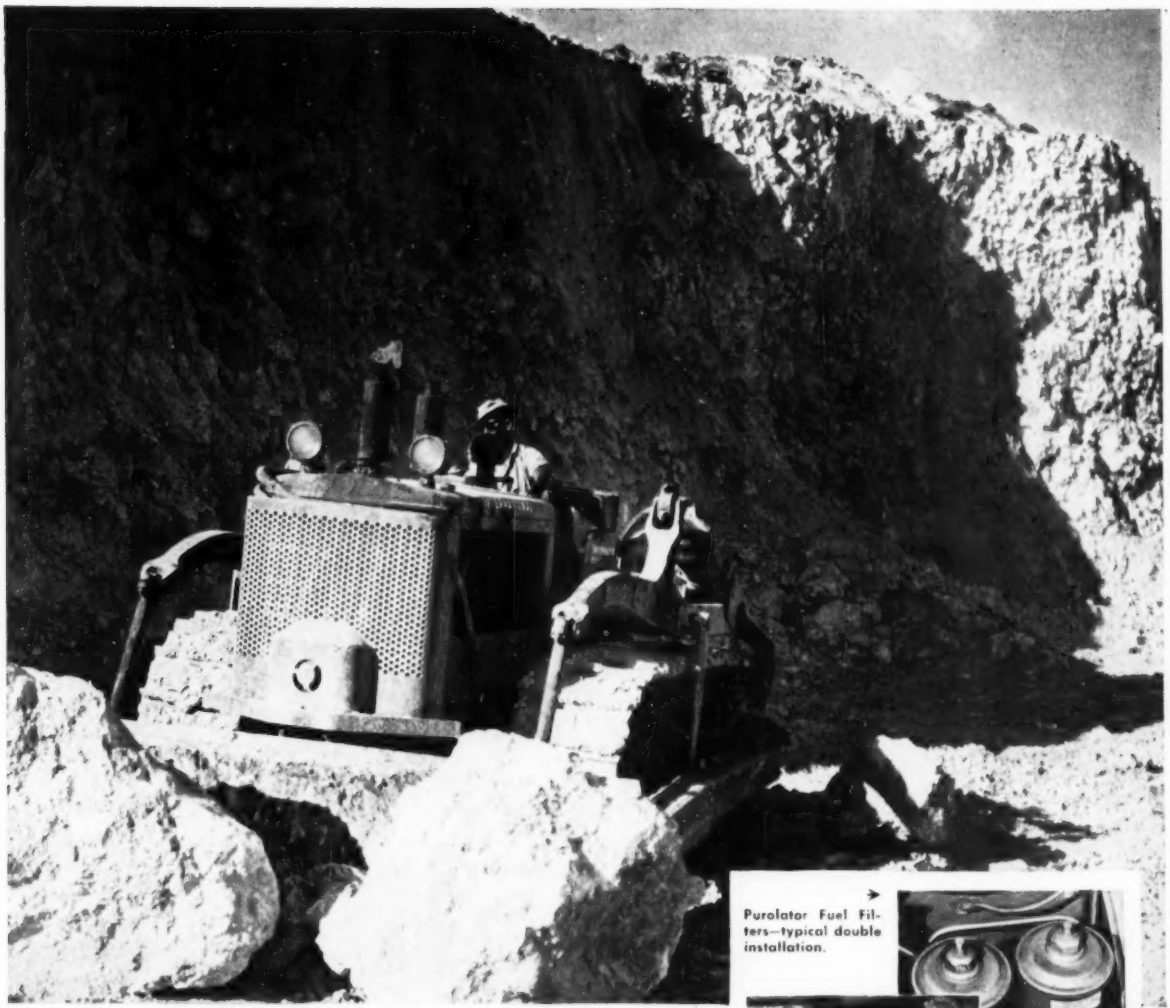
From aircraft ground power to telephone exchanges, these new G-E Tri-Clad synchronous generators fit hundreds of applications. See your G-E sales representative, he'll be glad to discuss your particular application. Or for more information, write for GEA-5470. *Section 765-1, General Electric Co., Schenectady 5, N. Y.*

Here are just a few of the places where these Tri-Clad generators give outstanding service—

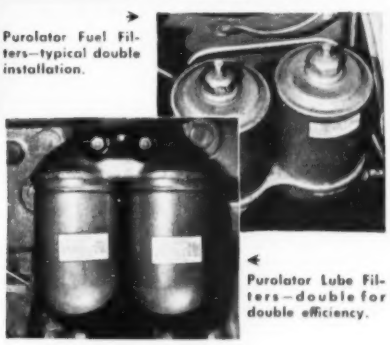
- airports
- marine operations
- construction projects
- mining operations
- industrial plants
- mobile applications
- pumping stations
- refineries
- shipyards
- municipal power

GENERAL ELECTRIC

765-1



CLEANING UP *with an International TD-18 Diesel Crawler tractor that's filter-protected with Purolator Oil Filters.*



Purolator Fuel Filters—typical double installation.

Purolator Lube Filters—double for double efficiency.

Where there's rock, there's dust . . .

And where there's dust, there's engine trouble unless there's *filter-protection.*

For engines breathe dust and dirt with every turn of the crankshaft—need fuel and lube oil filtration to protect pistons, cylinder walls, bearings and fuel systems.

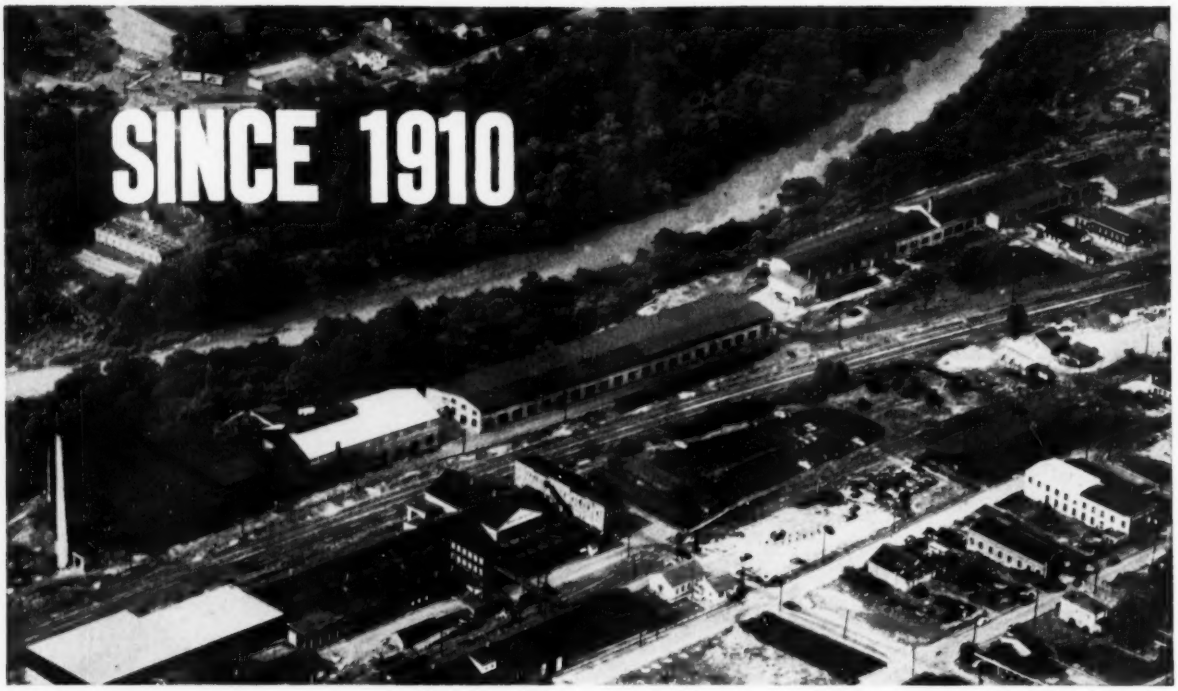
For filter protection: rely on the Purolator* Micronic*. Purolator's element traps abrasive measured in microns (.000039 of an inch) . . . has a revolutionary accordion-pleated design which provides a filtering area as much as 10 times that of old-style filters . . . won't warp or disintegrate.

Whatever your filtering problem, let our engineering staff show you how to solve it! *Reg. U. S. Pat. Off.

Protect your Power with...

PUROLATOR PRODUCTS, INC.
Rahway, New Jersey and Toronto, Ontario, Canada
Factory branch offices: Chicago, Detroit, Los Angeles

PUROLATOR
MICRONIC OIL FILTER
"FIRST IN THE FIELD OF FILTERING"



This aerial view of our plant will give you a good idea of our facilities for turning out crankshafts and forgings for diesels.

We have been at it since 1910, during which time we have been furnishing a constant and steady supply of crankshafts and forgings for use on diesel engines.

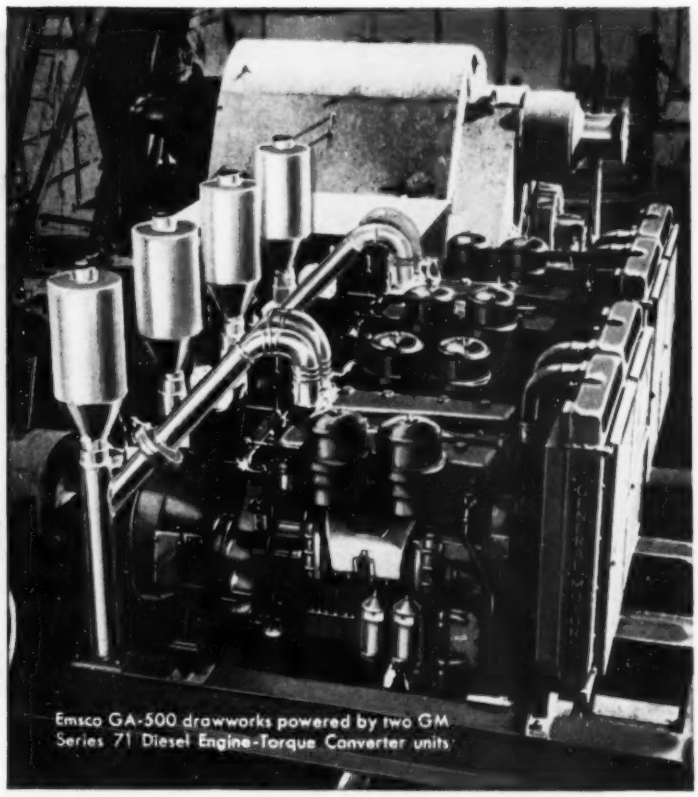
Manufacturers of diesels rely upon Ellwood City Forge for their most exacting requirements. We never disappoint them.

We suggest you write or look in on us for your crankshafts and forgings. We can take care of your needs in a thoroughly satisfactory manner.

Ellwood City Forge Company

ELLWOOD CITY PENNSYLVANIA

PULLED 53 STANDS in *52 Minutes!*



Emsco GA-500 drawworks powered by two GM Series 71 Diesel Engine-Torque Converter units

FOWLER Drilling Company, Long Beach, California, reports that this General Motors Diesel-powered Emsco rig pulled 4800 feet (53 stands and one single) of 4½" drill pipe and 4 drill collars in 52 minutes.

C. L. "Slim" Fowler, president, says *"Over two years ago, we also bought a National 50 drilling rig powered by two GM Diesel Twins and until only recently we spent nothing for repairs. Those engines are still running fine and have not been overhauled. That record plus the high output and easy moving convinced us."*

Drilling hole faster with GM Diesel power is a common experience among cost-wise drilling contractors everywhere. These high-speed 2-cycle Diesels pack more power in less space. This means fewer units; faster, lower-cost moves; quicker setups. They make faster round trips and—with readily accessible, interchangeable parts—they take less time off for service.

Discover how these efficient, lighter-weight, 2-cycle Diesels can cut your drilling costs. Get the story from your local GM Diesel distributor or write direct to us.

DETROIT DIESEL ENGINE DIVISION

SINGLE ENGINES... *Up to 275 H. P.* **DETROIT 28, MICHIGAN** MULTIPLE UNITS... *Up to 800 H. P.*

GENERAL MOTORS

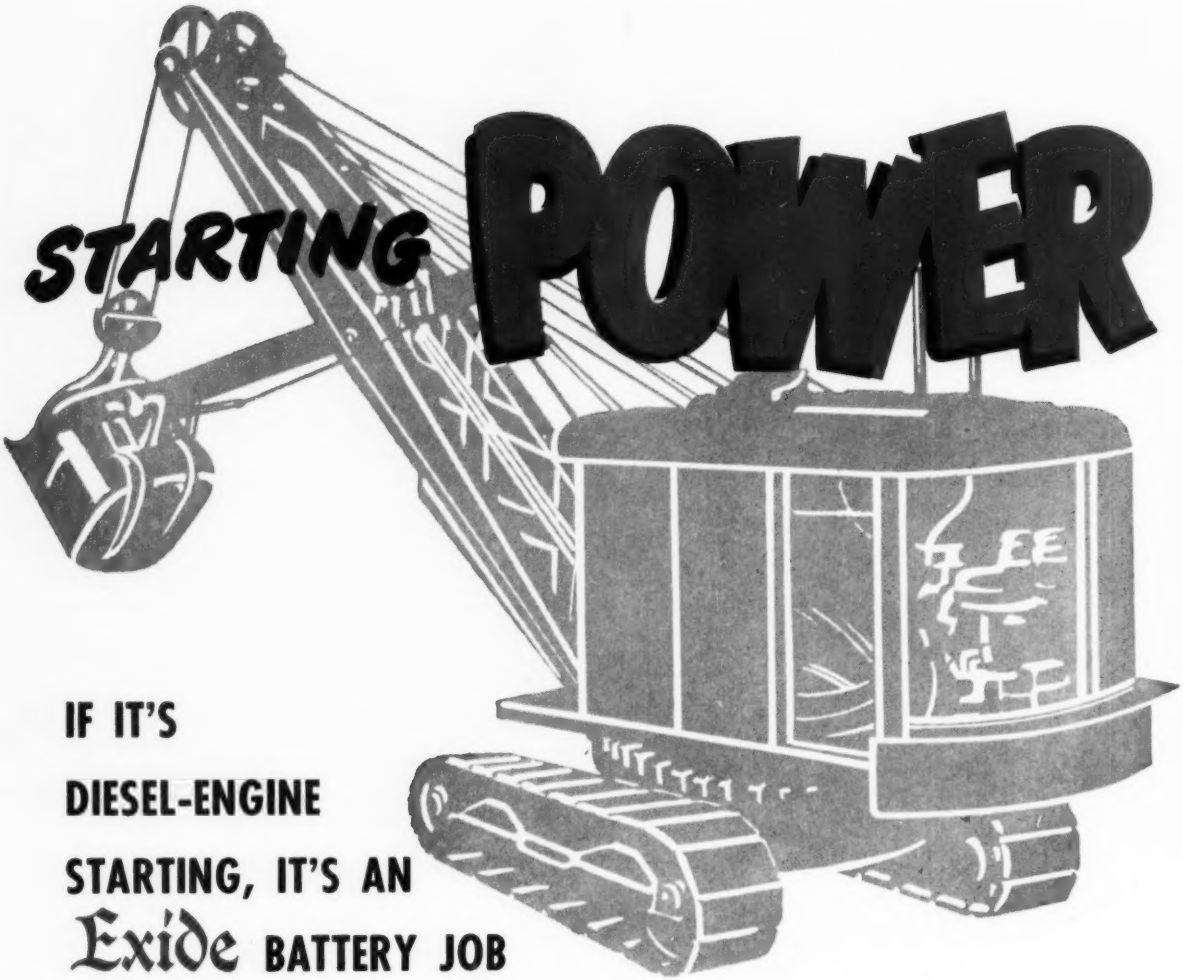
DIESEL BRAWN WITHOUT THE BULK

GM GENERAL MOTORS DIESEL POWER

GENERAL MOTORS CORP., DIESEL ENGINE SALES, PETROLEUM INDUSTRY, 1504 Philtower Bldg., TULSA 3, OKLAHOMA

CALIFORNIA: Anderson-O'Brien Co., LOS ANGELES 21; Lawless Brothers, BAKERSFIELD; West Coast Engine & Equipt. Co., BERKELEY. **ILLINOIS:** Western Machinery & Engine Co., CENTRALIA. **KANSAS:** Diesel Equipment Co., Inc., WICHITA. **COLORADO:** Colorado Builders' Supply Co. (Equipt. Division), DENVER. **LOUISIANA:** George Engine Co., Inc., HARVEY; United Tool Company, SHREVEPORT. **MISSISSIPPI:** Taylor Machine Works, JACKSON. **MISSOURI:** Western Machinery & Engine Co., ST. LOUIS 10. **MONTANA:** Seitz Machinery Co., Inc., BILLINGS; Mountain Tractor Co., MISSOULA. **OKLAHOMA:** Diesel Power Co., OKLAHOMA CITY. **TEXAS:** Stewart & Stevenson Services, Inc., HOUSTON 1, McALLEN, DALLAS, CORPUS CHRISTI, WICHITA FALLS; Haynes Machinery Co., PLAINVIEW; Empire Machinery Co., Ltd., ODESSA. **WYOMING:** Colorado Builders' Supply Co. (Equipt. Division), CASPER.

STARTING POWER



IF IT'S DIESEL-ENGINE STARTING, IT'S AN Exide BATTERY JOB

For dependable, all-weather, diesel starting, choose the battery that's designed specifically for the job—a powerful, long-lasting Exide. Back of it are years of ceaseless research-engineering and battery-building experience to give you assured starting, day after day, under the most severe operating conditions. With Exide batteries you get:

HIGH MAINTAINED VOLTAGE for a *quick breakaway* and *high cranking speeds.*

EXTRA LONG LIFE—low depreciation, less frequent replacements.

LOW COSTS—operation, maintenance, repair.

RUGGED CONSTRUCTION for rough usage and hard service.

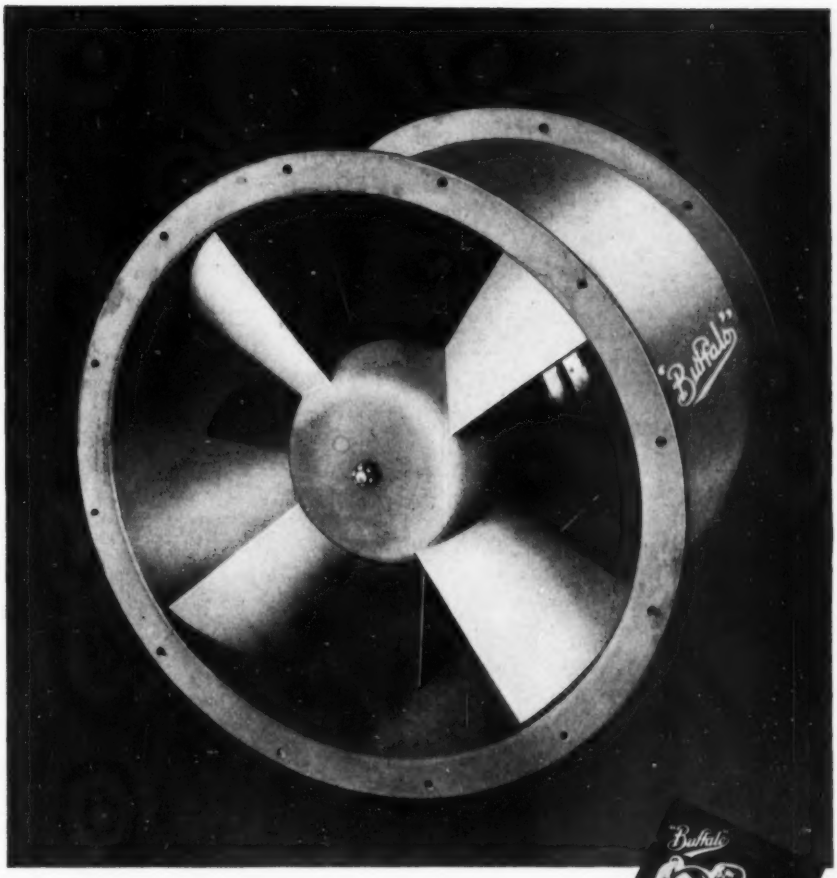
Use Exide diesel-starting batteries for all heavy-duty service . . . in buses, trucks, tractors, off-the-highway equipment, ships, aircraft, power plants, diesel-electric locomotives.

THE ELECTRIC STORAGE BATTERY CO.
Philadelphia 2
Exide Batteries of Canada, Limited, Toronto
"Exide" *Reg. Trade-mark U. S. Pat. Off.*

WHEN IT'S AN EXIDE YOUR DIESELS START

1888 . . . DEPENDABLE BATTERIES FOR 63 YEARS . . . 1951

THIS DIESEL COOLER is a *Space Saver!*



"Buffalo" AXIAL FLOW FAN

Diesel cooling fans, particularly those for mobile Diesels, must be compact. At the same time, they must be capable of comparatively high velocity delivery for efficient cooling. Such are the characteristics of "Buffalo" Type "B" Vaneaxial Fans. Their housing permits mounting like a section of duct . . . with motor, propellor, inlet vanes and all *inside*. Their "Beeline" design lets air pass straight through for highest efficiency. And their light weight reduces installation cost. Write for Bulletin 3533-C for specifications and performance data.

BUFFALO FORGE COMPANY

140 MORTIMER ST. BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Branch offices in all Principal Cities

EVAPORATIVE COOLERS AND AXIAL FLOW FANS FOR COOLING MOBILE AND STATIONARY DIESELS

ANNOUNCING...

The NEW SHELL ROTELLA OIL

(Extra Heavy Duty Type)

"... exceeds every accepted performance standard for oils in its class"

OUTSTANDING PISTON CLEANLINESS

The new Shell Rotella Oil stands out in the very top bracket with respect to Piston Cleanliness, providing convincing proof of its ability to keep contaminants out of the critical zone in which wear is concentrated.

MUCH LOWER RING DEPOSITS

Ring-plugging tests are really tough, yet new Shell Rotella Oil came through stiff competition with a remarkably low ring deposit rating . . . far below the established passing mark!

GREATER ENGINE LIFE

Recognized laboratory engine tests are important in establishing qualifications of lubricants to meet strict requirements. More important to operators, however, is the *tremendous increase in engine life* and the consequent reduction in maintenance expense and time out-of-service that the new Shell Rotella Oil is contributing to fleet operation under today's conditions.

NEW SHELL ROTELLA OIL . . .

Stepped up cleaning action...

Even greater anti-wear protection

. . . anticipating the needs of today's high performance fleet engines

TODAY'S hauling conditions are imposing greatly increased demands upon fleet engines . . . and the lubricants selected to keep them running. At the same time these high-performance engines are expected to turn in ever-increasing mileage records between overhauls.

For these reasons, and because even greater performance will probably be expected as time goes on, the detergent-dispersant and anti-wear qualities of Shell Rotella Oil have been markedly increased.

Operators using Shell Rotella Oil in the past will find an even greater latitude in maintenance procedures.

4-WAY LIFE EXTENSION FOR BUSY ENGINES

1. Remarkable detergent-dispersant action

The ability to suspend contaminants has been deliberately stepped up in the new oil. Field tests on vehicles, in widely varying kinds of service, prove conclusively that this greater detergent-dispersant action extends mileage between overhauls.

2. Drastic sludge reduction

Operators who have been having sludge troubles . . . with clogged pump screens, burned out bearings, or clogged oil ways . . . are urged to find out for themselves how remarkably clean those engines will remain while using this new anti-sludge Shell Rotella Oil.

3. Positive Anti-acid action

New Shell Rotella Oil directly counteracts the acid action of fuel combustion products in the vital top-cylinder zone . . . with correspondingly great reduction in wear. This protection is extremely important in the operation of intermittently loaded engines.

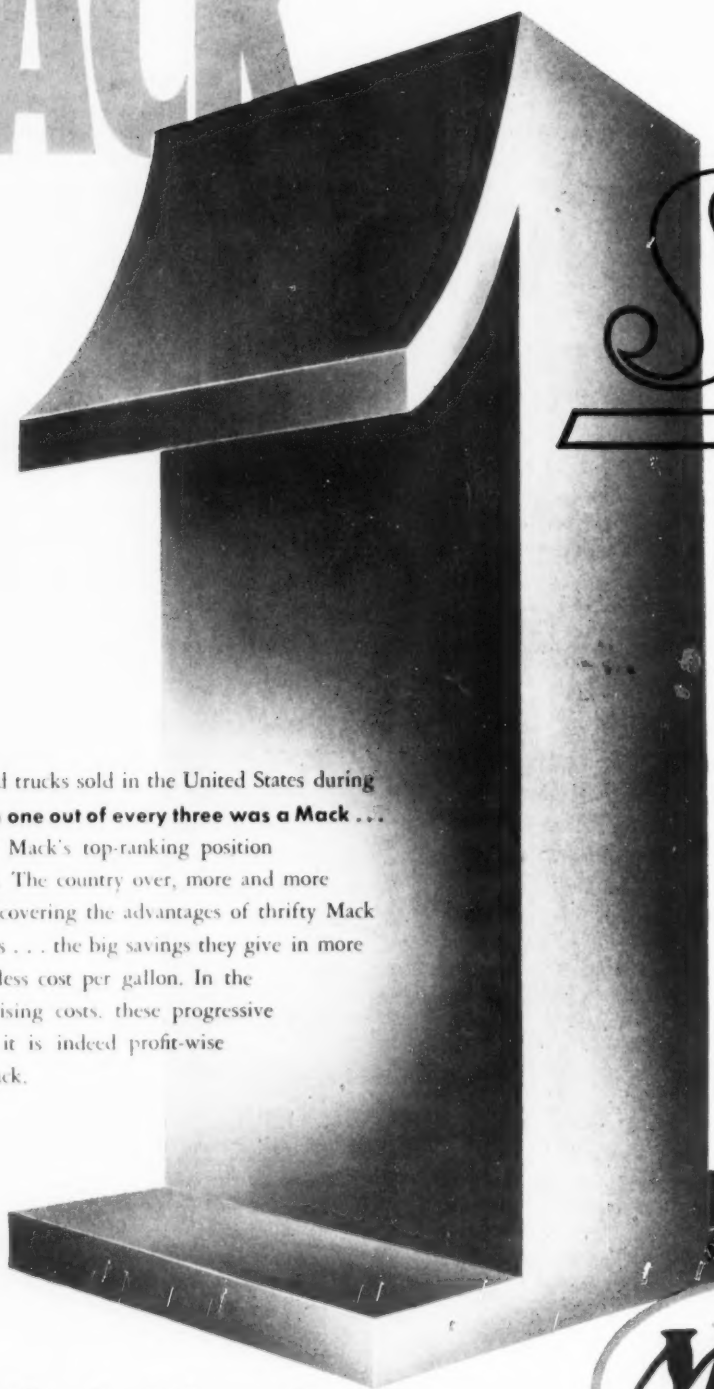
4. Extends time between engine overhauls

New or reconditioned engines . . . operating on fuels of widely-varying quality . . . in all kinds of fleet service . . . have demonstrated an important extension of in-service time. *This gain results from improvement in several basic respects: freedom from sludge and ring-clogging, increased valve life and greatly reduced wear.*

SHELL

for all heavy duty fleet engines

MACK



1st IN DIESEL TRUCK SALES

Of all diesel-powered trucks sold in the United States during 1950 . . . **better than one out of every three was a Mack . . .** striking evidence of Mack's top-ranking position in diesel truck sales. The country over, more and more truck owners are discovering the advantages of thrifty Mack diesel-powered trucks . . . the big savings they give in more miles per gallon at less cost per gallon. In the face of constantly rising costs, these progressive operators find that it is indeed profit-wise to dieselize with Mack.

Be Profit-Wise... Dieselize with Mack TRUCKS

outlast them all

Mack Trucks, Empire State Building, New York 1, N. Y. Factories at Allentown, Pa.; Plainfield, N. J.; Long Island City, N. Y. Factory branches and distributors in all principal cities for service and parts. In Canada: Mack Trucks of Canada, Ltd.

Clean Lube— Full Flow— with the TRULY POSITIVE Strainer

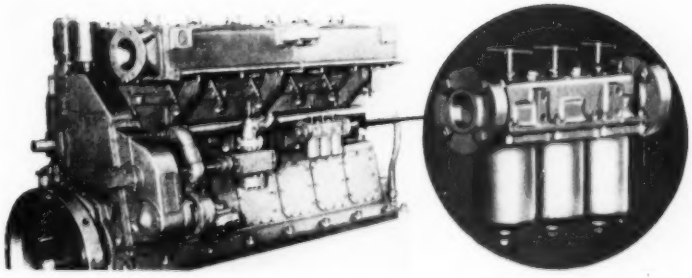
Sludge and other contaminants don't have a chance when the lube has to pass through a Cuno AUTO-KLEAN every time around.

The fixed-spaced metal discs in this modern strainer positively remove all solids larger than specified.* Cuno *guarantees* that.

The filter cartridge itself is cleaned positively and without stopping flow. Cleaner blades reach into the slots between discs to "comb out" all dirt, no matter how sticky or deeply embedded. This type of cleaning is much more thorough than mere surface-scraping . . . restoring full initial capacity—and there's no danger of the dirt being pushed through into the discharge flow.

Cuno AUTO-KLEAN discs are permanent, non-collapsible, unbreakable. No chance of an unsuspected gap or channel to occur, permitting passage of harmful solids. And —nothing to wear out and need replacing.

For permanent, positive Diesel protection, install compact Cuno AUTO-KLEAN. Send the coupon for free bulletin.



COMPACT, CONTINUOUSLY CLEANABLE Cuno AUTO-KLEAN Strainers are available for built-in or external installations, handling full flow in minimum space.

Continuously-cleanable feature permits single unit installations. Straight line connections for simplicity of installation on either fuel or lube. Can be cleaned periodically by hand or continuously by motor drive, without shutting down operation. Cleaning of the discs is accomplished—manually or by motor—while still operating.

**Models available for straining from .0035 to .062 in.*

SEND COUPON FOR INFORMATION ON CLEANING BOTH LUBE AND FUEL

CUNO

Complete Line Fluid Conditioning

Removes More Sizes of Solids from More Types of Fluids

MICRONIC (Micro-Klean) • DISC-TYPE (Auto-Klean)
WIRE-WOUND (Flo-Klean)

Cuno Engineering Corporation
2510 South Vine Street, Meriden, Conn.

Please send me free bulletin on Cuno AUTO-KLEAN Strainer for Diesel engine protection.

Name..... Title.....

Company.....

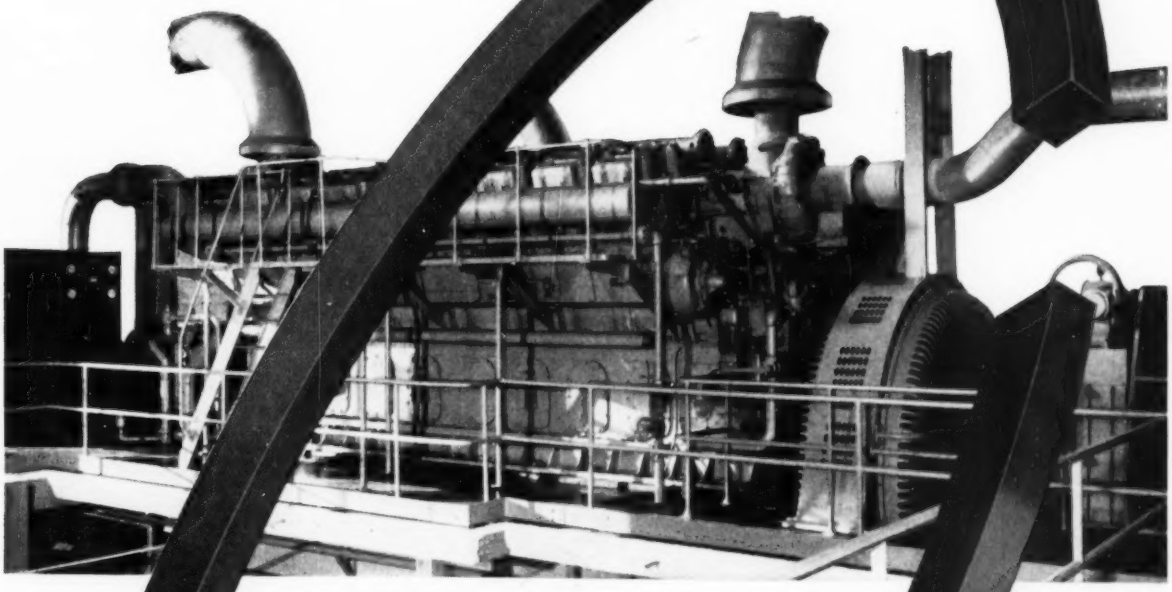
Address.....

City..... State.....

PLEASE ATTACH COUPON TO YOUR BUSINESS LETTERHEAD

Choose from the complete Alnor Line
for the Thermocouple Performance You Need
For every diesel—from the largest Power Plant to the smallest auxiliary—there is an Alnor thermocouple specially designed to give consistently accurate service. These exceptionally rugged couples have proved in years of top performance that they can give precision operation under all conditions . . . in all applications. In fact they have been specified by every major engine manufacturer as original equipment.
Choose the type and style you need—in a wide price range. Take advantage of the Alnor design, which assures non-rust, waterproof, dustproof and corrosion-resistant performance. Send for information on the rigid types, featuring easily detachable stem and "no thread" conduit connections—an Alnor exclusive. Or if your thermocouple problem calls for a flexible, detachable style, ask about the flexible Alnor types with non-rusting cables that will not crack or break under the toughest handling.
SEND FOR BULLETIN.
Illinois Testing Laboratories, Inc. Room 507, 420 N. La Salle Street, Chicago 10, Illinois
Alnor
PRECISION INSTRUMENTS
FOR EVERY INDUSTRY

KOPPERS Porous Chrome Rings keep maintenance costs to a minimum in diesel power plant



Koppers K-Spun Piston Rings, produced by centrifugal casting process, are *100% stronger . . . four times more resistant to combustion shock than ordinary rings! They will not break in installation or for the life of the engine.*

Koppers Porous Chrome* Rings have a porous chrome surface that holds and distributes oil during break-in, quickly wears down to perfectly seated solid chrome that prevents grit and other particles from embedding in the ring surface where they can scratch cylinder walls. Porous Chrome Rings last up to four times as long as other rings, reduce cylinder wear 50% or more.

That's why engineers everywhere are reporting amazing savings in equipment and maintenance costs through the use of Koppers Rings. Remember . . . we make rings for any equipment that uses piston rings.

*VAN DER HORST PROCESS

If you have a piston ring problem, why not get the *right* answer from us? Write, wire or phone Koppers Co., Inc., Piston Ring Dept., 1544 Hamburg St., Baltimore 3, Md.

KOPPERS

KOPPERS

AMERICAN HAMMERED

PISTON RINGS

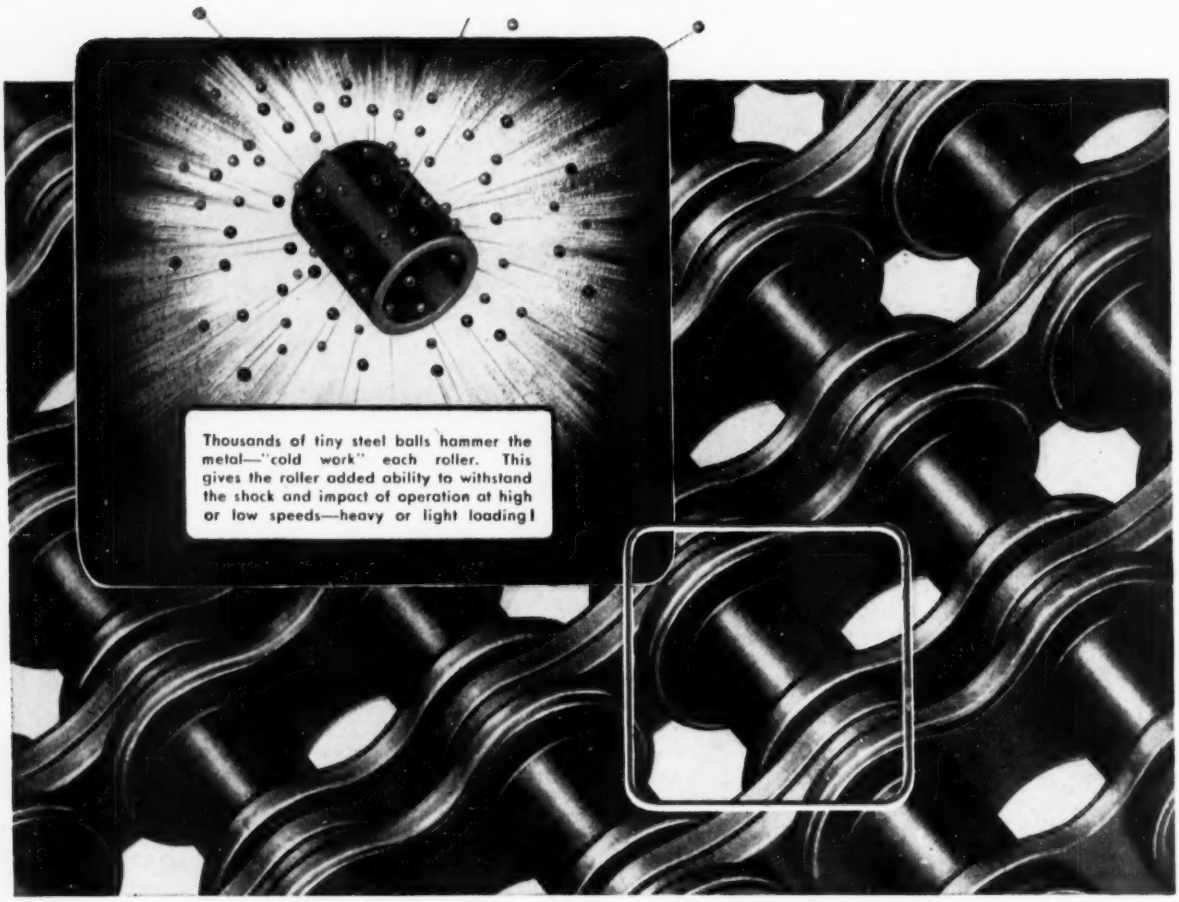
SPECIFY: Fast's Couplings . . . Koppers Piston Rings . . . both famous products of the Koppers Co., Inc.

ONLY KOPPERS CAN FURNISH K-SPUN OR POROUS CHROME!

Get the roller chain with rollers that are

SHOT PEENED

for EXTRA fatigue life!


Thousands of tiny steel balls hammer the metal—"cold work" each roller. This gives the roller added ability to withstand the shock and impact of operation at high or low speeds—heavy or light loading!

You get this added feature in every LINK-BELT Roller Chain

You get absolute uniformity, too. No highs. No lows. Just smooth, flowing dependable chains that pay off in wide flexibility—greater performance—longer life.

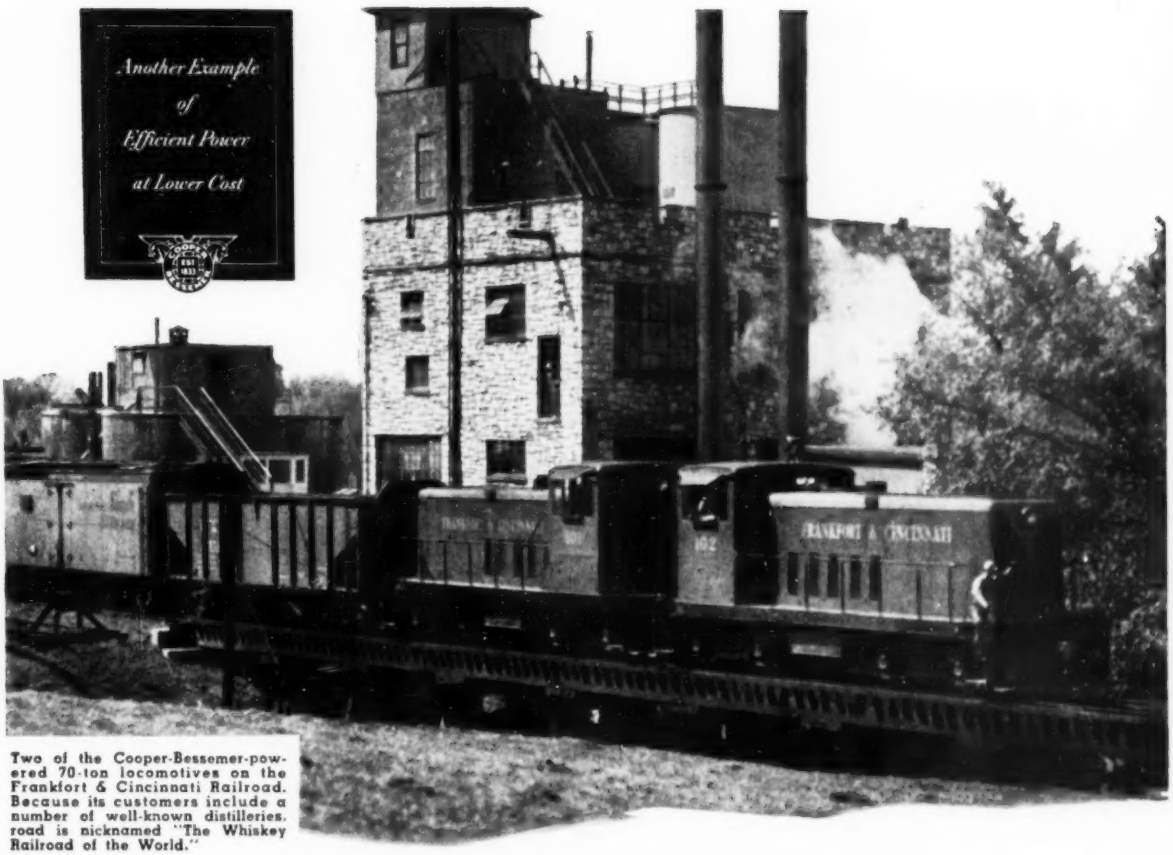
You see, LINK-BELT Roller Chains are made from carefully selected materials with controlled heat treatment to assure uniformity and absence of weak members, then—rollers are shot peened to give them the extra fatigue life needed for today's higher speeds and heavier loads.

Link-Belt Roller Chain is available in single or multiple widths, in $\frac{3}{8}$" to 3" pitch and double pitch. If you have a roller chain problem, see the LINK-BELT engineer nearest you.

LINK-BELT

ROLLER CHAINS and SPROCKETS

LINK-BELT COMPANY. Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Johannesburg. Offices, Factory Branch Stores and Distributors in principal cities. 12.207



Two of the Cooper-Bessemer-powered 70-ton locomotives on the Frankfort & Cincinnati Railroad. Because its customers include a number of well-known distilleries, road is nicknamed "The Whiskey Railroad of the World."

Maybe the diesels that "Saved a railroad" can help YOU cut costs

WHETHER your plans call for stationary, marine, or locomotive power, the facts in the case of the Frankfort & Cincinnati Railroad might be your cue to big savings.

On this short-line railroad, three Cooper-Bessemer-powered 70-ton diesel-electric locomotives are now doing the work of *seven* steamers. They are giving close to 98% availability! Maintenance cost has dropped from one-half to *one-fifth* of a cent per ton mile. Fuel costs run less than half! Net result is a *full 68% cut in operating costs!* In the words of George L. Fowler, president of the railroad, "If it hadn't been for the money saved by our diesels, our road just couldn't operate."

Here is a typical example of the steady work-loads that can be carried with unmatched economy and dependability by good diesels — the kind built by Cooper-Bessemer for *all* types of heavy-duty service.

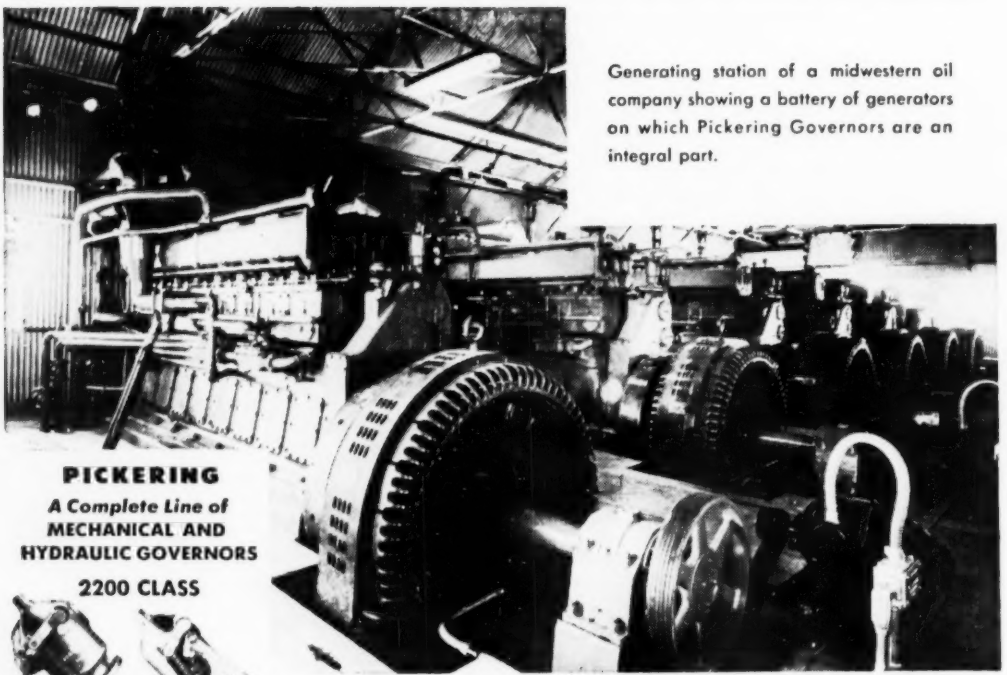
The
Cooper-Bessemer
Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York Washington, D. C. Bradford, Pa. San Francisco Houston Dallas Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Los Angeles Chicago Caracas, Venezuela Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Gloucester, Mass. Calmes Engineering Co., New Orleans, La.

PICKERING

Synonym for dependability since 1862



Generating station of a midwestern oil company showing a battery of generators on which Pickering Governors are an integral part.

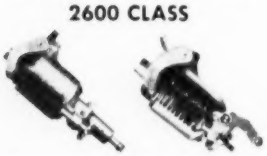
PICKERING

A Complete Line of
MECHANICAL AND HYDRAULIC GOVERNORS

2200 CLASS

Constant Speed Variable Speed

2600 CLASS

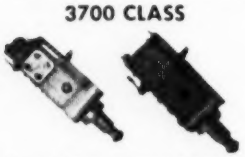


Constant Speed Variable Speed

3200 CLASS

Constant Speed Variable Speed

3700 CLASS



Constant Speed Variable Speed

For 89 years, Pickering Governors have met and anticipated the needs of American Industry. They have more than established a reputation for fully-dependable, long-term service under every type of operating condition.

Today, Pickering stands ready to supply the right governor for the job – to supply the governor that will maintain operating efficiency at its peak regardless of service conditions.

To consult Pickering Engineers may be your passport toward more efficient and economical operation of diesel equipment.

THE PICKERING GOVERNOR CO.

Established 1862

88 LLEWELLYN AVENUE · BLOOMFIELD, NEW JERSEY

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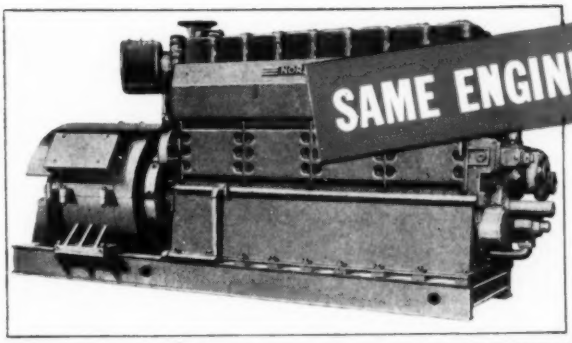

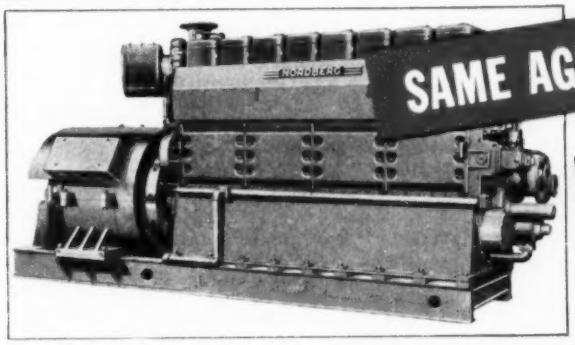

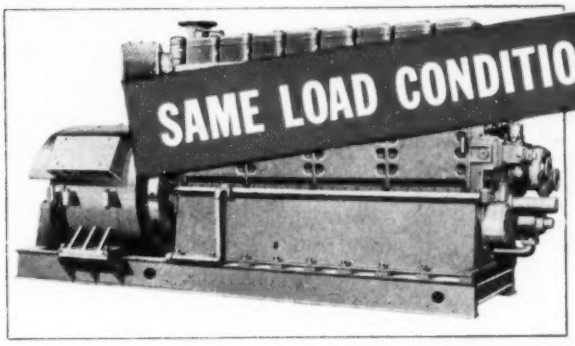

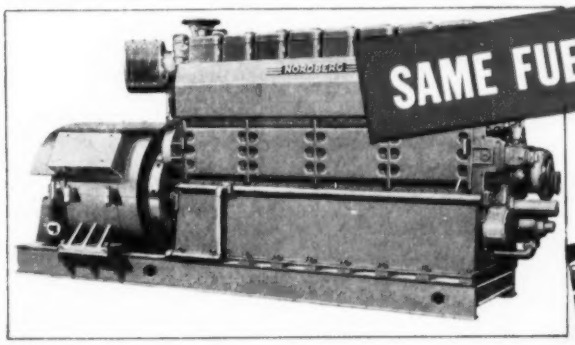

Yet Lubrication is Different!

Yes, it's not unusual. From the first day in service, every engine begins to develop its own lubricant "diet." Frequently it's a matter of care and attention given by the operator. Often it's caused by geographic or climatic differences. Certainly, no two engines ever built performed identically . . . wore out at the same time . . . or required the same amount and kind of lubricant for best performance.

For these reasons *your* Diesel engine investment should be protected with regular lubrication engineering service. A Cities Service representative is highly skilled, highly trained and thoroughly familiar with the lubrication requirements of every type of Diesel equipment. Moreover, behind him stands an alert, completely integrated oil company with a full line of top quality industrial lubricants. Contact the office nearest you or write below for further information.

A Complete Line of Top Quality Petroleum Products Including:

- **New Heavy Duty Diesel Oils**
- **New Low Speed Diesel Oils**
- **Exclusive Diesel Engine Oils**
- **Exhaust Analyzer Service**

FREE! THIS HELPFUL BOOKLET

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CITIES SERVICE OIL COMPANY
Sixty Wall Tower, Room 908
New York 5, N. Y.

Please send me without obligation your new booklet entitled "Diesel Engine Lubrication."

Name _____

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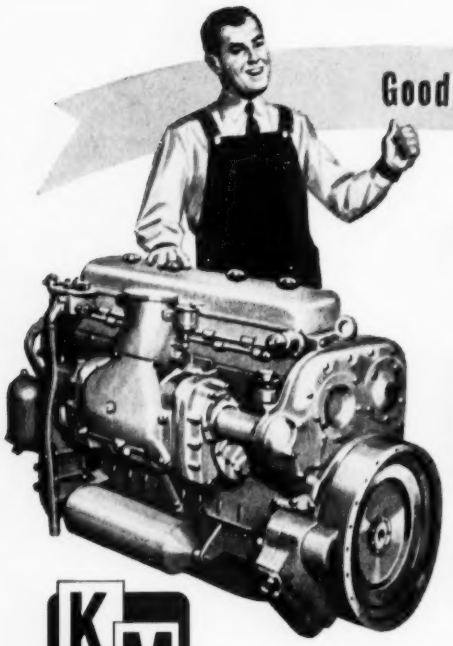


Good news for owners of G M DIESEL ENGINES!

You can save time, eliminate parts damage by maintaining your equipment with

KENT-MOORE

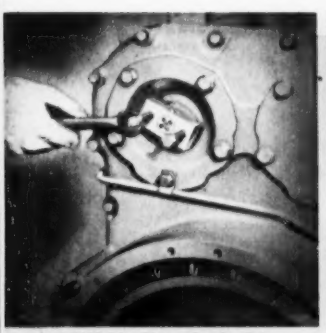
SPECIAL SERVICE TOOLS

Ease and speed of maintenance have always been important "plus factors" in favor of G.M. Diesel Engines. Take the basic simplicity of their famous 2-cycle design, for example. Note the interchangeability of their low-cost, standardized parts. Then, too, consider the amazing added efficiency with which recommended maintenance operations can be performed... thanks to Kent-Moore Special-Purpose Service Tools.

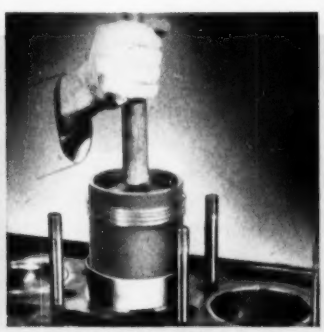
Yes, once you've used them, you'll agree there's something *extra special* about these Kent-Moore Tools. For you see, they're "service engineered"... developed expressly to meet the essential maintenance requirements of *your* G.M. Diesel Engines. Each tool is designed to perform a specific service or repair operation for which no adequate standard tools exist. And each one is built to accomplish its particular job quickly, easily, accurately . . . without danger of damaging parts, and at lower cost than is possible by means of improvised makeshift methods.

So, whether you maintain your own engines . . . or whether you have them serviced by your G.M. Diesel distributor, you'll do well to insist upon the use of genuine Kent-Moore Special Service Tools.

You know the job's done right with Kent-Moore Special Service Tools!

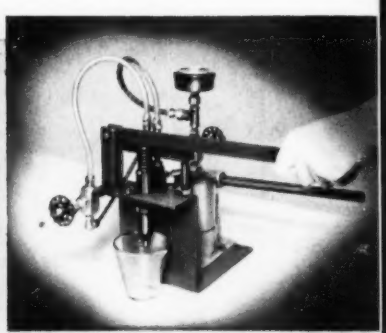


J 1682-CA—Blower Service Set



J 3272—Piston Installing Tool

J 1241-A—Injector Service Kit

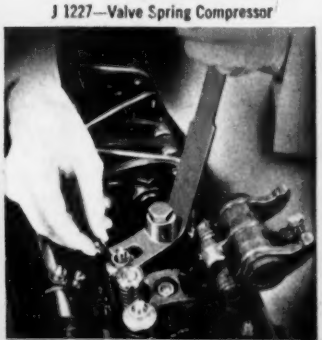


J 2620—Injector Testing Fixture

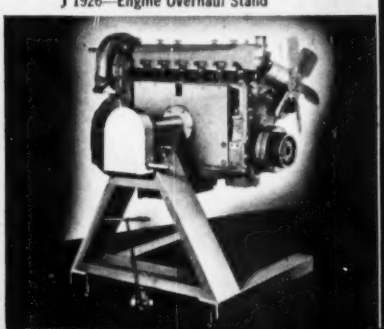
J 4254—Blower Shaft Installer

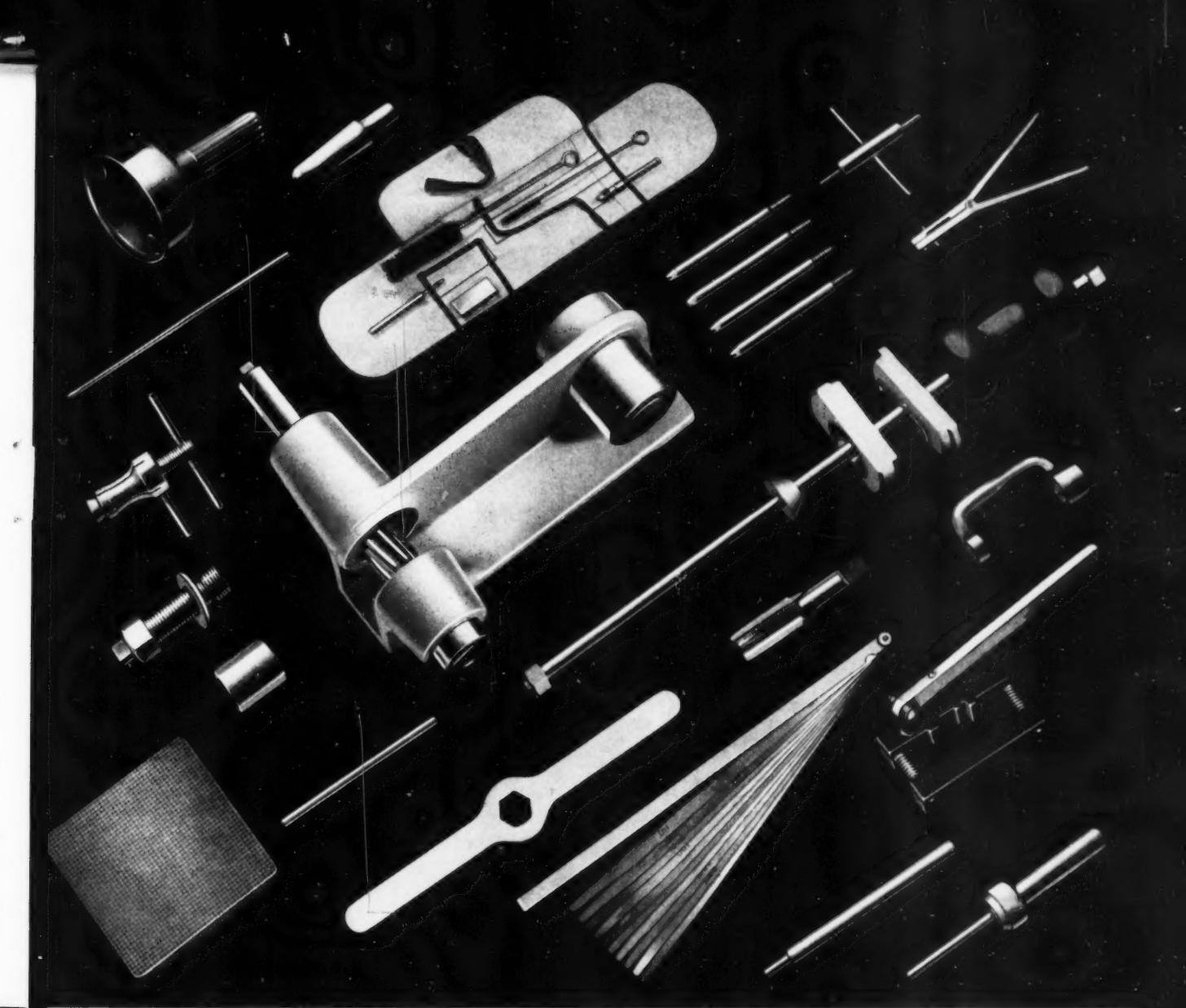
J 2202-A—Injector Copper Tube Remover

J 1227—Valve Spring Compressor



J 1926—Engine Overhaul Stand





SPECIAL TOOL REQUIREMENTS FOR BASIC REPAIR SERVICE ON GM DIESEL ENGINES

ENGINE OVERHAUL

TOOL NO.	DESCRIPTION	PRICE
J 1359	Crankshaft Oil Seal Expander	11.95
J 1686	Connecting Rod Bushing Reamer Set	79.50
J 1902-A	Camshaft Gear Puller	13.50
J 1927-A	Flywheel Housing Aligning Studs (4)	3.70
J 1928	Cylinder Head Stud Nut Wrench	5.20
KMO 232	Piston Ring Remover and Replacer	1.50
J 1903	Camshaft and Oil Pump Gear Replacer	4.95
J 1904-A	Flywheel Loosening Jack Screws	2.50
J 1909	Cylinder Liner Clamps (Set of 3)	4.75
J 1918	Cylinder Liner Remover	19.95
J 3272-A	Piston Inserter	11.95
J 3174-A	Feeler Gauge Set (For piston fitting)	2.75
J 1917-A	Tachometer Drive Puller	11.50

ENGINE TUNE-UP

TOOL NO.	DESCRIPTION	PRICE
J 1242	Injector Timing Gauge (Std. Output 1.484")	.95
J 1853	Injector Timing Gauge (High Output 1.460")	.95
J 1319-A	Cylinder Compression Gauge	38.50
J 1652-A	Governor Spring Retainer Nut Wrench	2.25
KMO 233	Valve Lash Feeler Gauge (.008"-.010")	.45
KMO 233-B	Valve Lash Feeler Gauge (.011" and .013")	.45
KMO 320	Fuel Pressure Gauge	4.95

CYLINDER HEAD OVERHAUL

TOOL NO.	DESCRIPTION	PRICE
J 2202-A	Injector Copper Tube Installer Set	15.95
J 267	Valve Guide Remover 11/32" Guide	1.85
J 4144	Valve Guide Replacer	2.90
J 3091	Valve Seat Insert Remover	15.95
J 1736	Valve Seat Insert Replacer	4.85
J 3087	Cylinder Head Holding Plates (Pair)	18.65

TERMS: *C.O.D. orders shipped net, F.O.B. Detroit. 5% discount allowed cash with order. All prices subject to change without notice, and all orders subject to confirmation by Kent-Moore Organization, Inc.*

KENT-MOORE ORGANIZATION, INC.

Engineers and Manufacturers of Special Automotive Service Tools and Equipment

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YOURS FOR THE ASKING! 24-Page Special Service Tool Guide for owners of G.M. Diesel Engines. Write Dept. D. for your free copy today!

MADISON-KIPP *Automatic* LUBRICATION

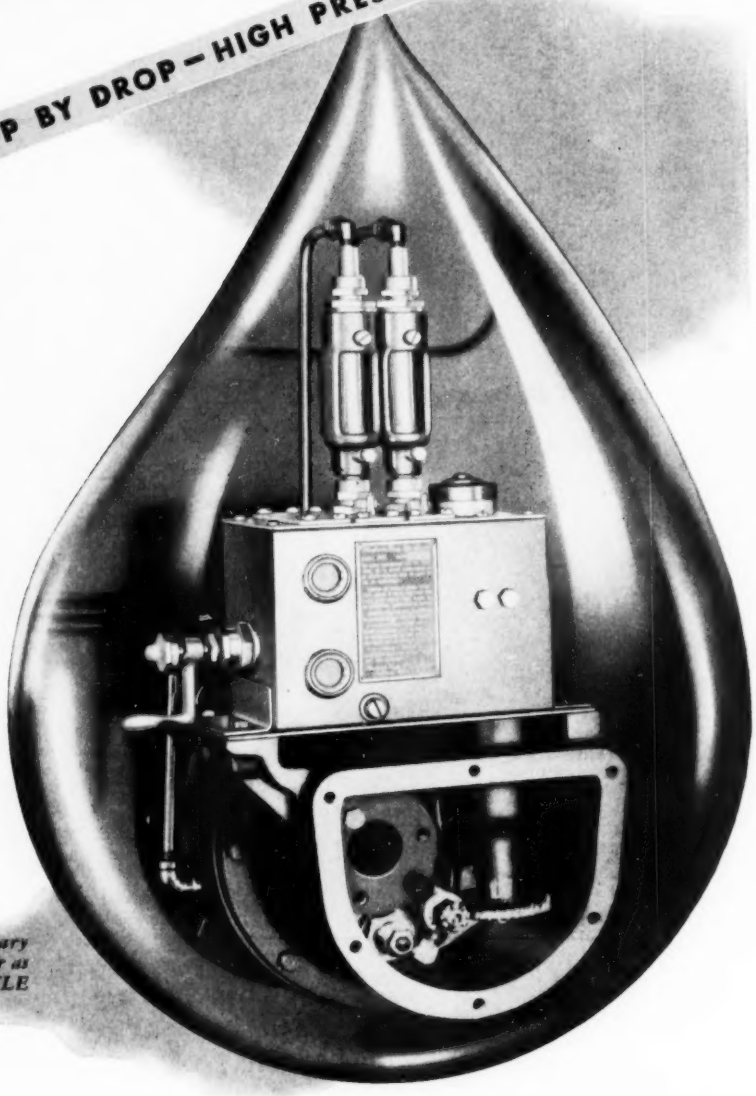
DRIVING SPEED REGULATED TO MACHINE SPEED

MEASURED FEED — DROP BY DROP — HIGH PRESSURE DELIVERY

HERE is a close-up illustration of an actual application of a Bottom Rotary Drive Model SVH Madison-Kipp Lubricator. The operator's responsibility is reduced to a minimum. The machine manufacturer has given his customer a life-time **plus** value.

Madison-Kipp is the most dependable method of lubrication ever developed and there are models to fit almost every original equipment requirement with automatic drives to fit every application.

Engineering details are, of course, yours for the asking.



Madison-Kipp Bottom Rotary Drive Model SVH Lubricator as applied to Ingersoll-Rand XLE Compressor.

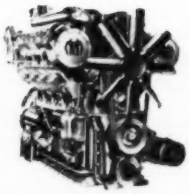
MADISON-KIPP CORPORATION

205 WAUBESA STREET, MADISON 10, WIS., U.S.A.

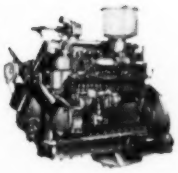
ANCIENS ATELIERS GASQUY, 31 Rue du Marais, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.

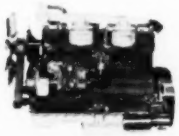
- *Skilled in* DIE CASTING *Mechanics*
- *Experienced in* LUBRICATION *Engineering*
- *Originators of Really High Speed* AIR TOOLS



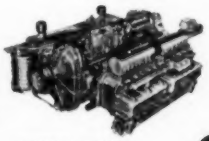
MODEL DNXV-8
Hercules 8 cylinder
Vee-Type Diesel Engine



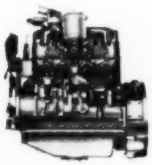
MODEL DIX6D
Hercules 6 cylinder
Diesel Engine



MODEL DFXH
Hercules 6 cylinder
Diesel Engine

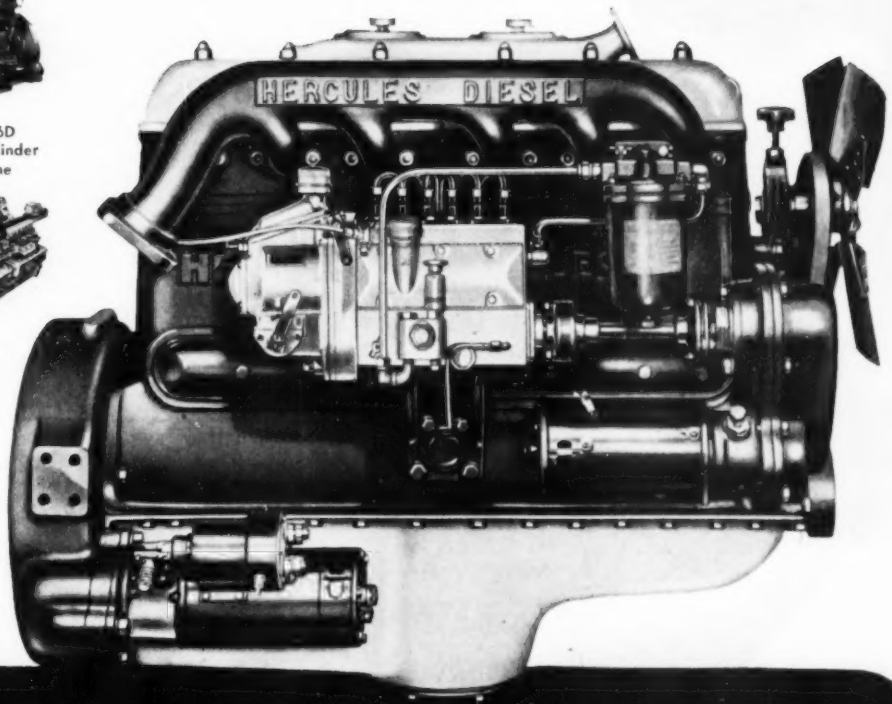


MODEL DFXHF
Hercules 6 cylinder
"Pancake" Type
Diesel Engine



MODEL DIX4D
Hercules 4 cylinder
Diesel Engine

MODEL DRX
Hercules 6 cylinder
Diesel Engine



HERCULES DIESELS

Model	Bore and Stroke Inches	Piston Displ. Cubic Inches
TWO CYLINDER DIESEL		
DIXC	4" x 4½"	113.1
DIXD	4¼" x 4½"	127.5
FOUR CYLINDER DIESEL		
DIX4B	3¼" x 4"	133
DIX4D	3⅝" x 4"	166
DOOB	3¾" x 4½"	198.8
DOOC	4" x 4½"	226.2
DOOD	4¼" x 4½"	255
SIX CYLINDER DIESEL		
DIX6D	3⅝" x 4"	248
DJXB	3½" x 4½"	260
DJXC	3¾" x 4½"	298
DJXH	3¾" x 4½"	298
DJXHF	3¾" x 4½"	298
DWXC	4" x 4¾"	358
DWXCF	4" x 4¾"	358
DWXD	4¼" x 4¾"	404
DWXDF	4¼" x 4¾"	404
DWXLD	4¼" x 5"	426
DWXLDF	4¼" x 5"	426
DRXB	4⅜" x 5¼"	474
DRXC	4⅜" x 5¼"	529
DFXB	5" x 6"	707
DFXC	5¼" x 6"	779
DFXD	5½" x 6"	855
DFXE	5⅝" x 6"	895
DFXH	5¾" x 6"	935
DFXHF	5¾" x 6"	935
EIGHT CYLINDER DIESEL		
DNXV-8C	6" x 6"	1348
DNXV-8D	6¼" x 6"	1468
DNXV-8DS	6¼" x 6"	1468

designed for the job!

No matter how tough the task . . . you'll find a lightweight, high-speed HERCULES heavy-duty diesel to do the job and do it well!

And, when it comes to continuous on-the-job performance...low per mile operating cost...maximum fuel economy...and minimum maintenance...you'll agree that Hercules Diesels are a profit-wise choice for dependable power.

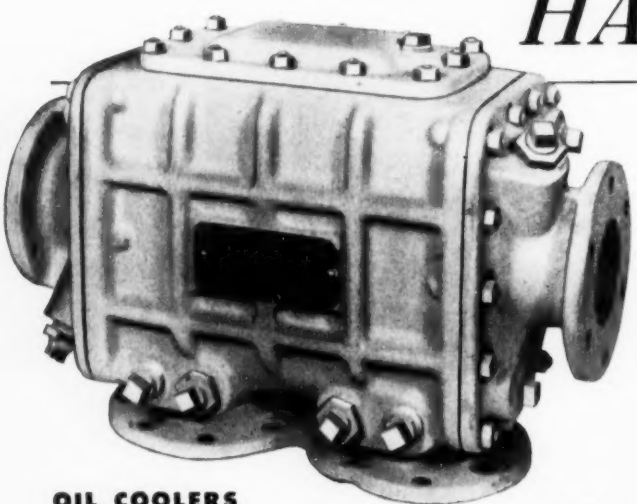
On your future diesel power requirements, be sure you capitalize on all the advantages offered by the patented Hercules combustion chamber. 14 series and 29 models, ranging from 12 to 500 horsepower, offer unlimited power applications. It will pay you well to discuss diesel power with a Hercules engineer. No obligation, of course.

HERCULES MOTORS CORPORATION, *Canton, Ohio, U.S.A.*

marine engines

are cooled by

HARRISON



OIL COOLERS
JACKET-WATER COOLERS

Builders of marine engines know they can depend on Harrison heat exchangers.

They know that Harrison jacket-water coolers and oil coolers are designed *right* . . . and built to *last*.

Harrison's engineering staff and technical facilities are available to marine engine builders at all times.

HARRISON

HARRISON RADIATOR DIVISION,
GENERAL MOTORS CORPORATION,
LOCKPORT, N. Y.

Is Your Service SEVERE?

Do your diesels have to handle frequent peak loads? Or operate continuously at high temperatures? Or have long idling periods? Then Sinclair GASCON OIL HD is the lubricant for you.

This heavy-duty, additive-type oil has increased cleansing and dispersion action, and resistance to oxidation. It inhibits deposits and ring-sticking; protects bearings from corrosion and is non-foaming. It keeps diesel engines clean despite punishing operating conditions and assures fuel and maintenance economy.

GASCON OIL HD in your diesels will pay dividends.

• • •

Diesel locomotives live a harder life than most stationary diesels—accelerating, slowing up, climbing grades . . . amid changing climatic conditions. GASCON® OIL HD has proven itself in this difficult service. It is used by over 60 of America's top railroads to protect their costly locomotive investment.

For lubrication counsel, see your nearest Sinclair Representative or write direct to Sinclair Refining Company, 630 Fifth Avenue, New York 20, N. Y.

ONE SHARPLES CENTRIFUGE CONVERTS BUNKER C OIL TO AN ECONOMICAL DIESEL FUEL

Since 1932 Sharples single unit centrifugal systems have been saving thousands of dollars a year in fuel costs . . . by burning heavy fuel instead of regular diesel fuel at a New England public utility, it is estimated that a saving of approximately $11,950 a year at present fuel rates will be effected . . . a leading diesel manufacturer is recommending Sharples Oil Purifiers for use with their engines based on experience in their own power plant. With a Sharples centrifuge, double centrifuging is not necessary to effectively purify heavy oils.

Sharples assures you of one undivided responsibility and guaranteed performance. We will be glad to discuss with you the profitable use of Bunker C as a diesel fuel, without obligation.

SHARPLES

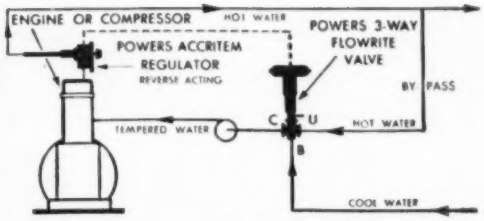
THE SHARPLES CORPORATION • 2300 WESTMORELAND STREET, PHILADELPHIA 40, PENNA.

NEW YORK • BOSTON • PITTSBURGH • CLEVELAND • DETROIT • CHICAGO • NEW ORLEANS • SEATTLE • LOS ANGELES • SAN FRANCISCO • HOUSTON

Before You Buy

JACKET WATER TEMPERATURE CONTROL

Investigate



One of Many Applications of
POWERS ACCRITEM REGULATOR and FLOWRITE DIAPHRAGM VALVE—
Compressed Air or Water Operated

—Provides positive, dependable control for large size 3-way or 2-way valves. ***Safety feature*** of hook-up above: failure of air or water pressure allows only cooling water to flow through the valve to engine.

POWERS

Complete Line of Dependable, Time-Tested Regulators

IMPORTANT ADVANTAGES that quickly pay back the cost of Powers self-operating and pneumatic controls for air compressors, diesel and gas engines:

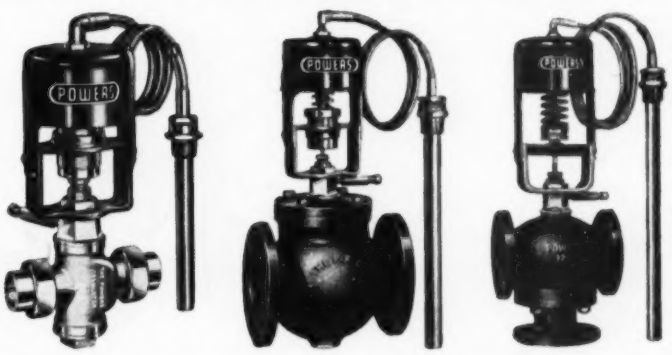
- **Correct jacket water and lube oil temperature at all times, regardless of load or seasonal changes.**
- **Improved lubrication and cylinder liner wear.**
- **Fewer piston ring replacements.**
- **Saves Labor; increases efficiency.**
- **Reduces danger of piston seizure.**
- **Eliminates sludging.**
- **Lowers fuel and lube oil consumption.**

Cost of Powers jacket water temperature control? About the same as a set of new piston rings. Powers regulators are unsurpassed for reliability and years of trouble free service.

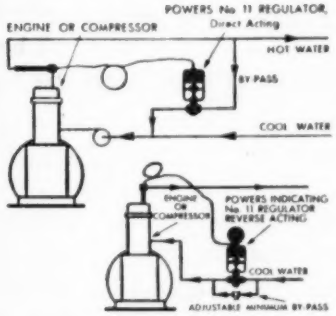
Have a POWERS Engineer call to study your requirements for better jacket water temperature control. There's no obligation. Phone or write our nearest office.

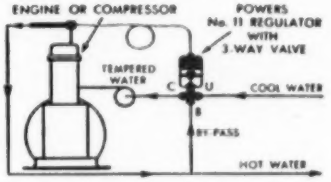
CHICAGO 14, ILLINOIS • 2710 Greenview Avenue
NEW YORK 17, NEW YORK • 231 East 46th Street
LOS ANGELES 5, CALIF. • 1808 West 8th Street
TORONTO, ONTARIO • 195 Spadina Avenue
MEXICO, D. F. • Edificio "La National" 601
(DIG)

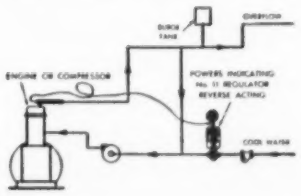
No. 11 Self-Operating TEMPERATURE REGULATORS

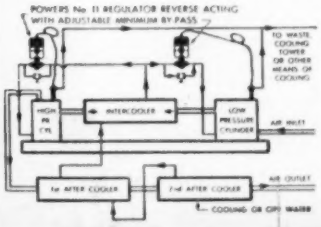


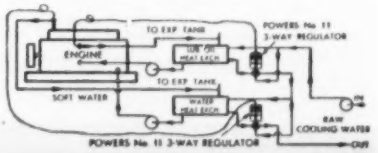
Provide dependable control for most applications. They're simple, ruggedly built, economical and easy to install. Especially suited for air compressors, diesel and gas engines. Temperature indicating regulator also available.








POWERS No. 11 REGULATOR REVERSE ACTING WITH ADJUSTABLE MINIMUM BY-PASS
TO WASTE, COOLING TOWER OR OTHER MEANS OF COOLING
INTERCOOLER
AIR INLET
AIR OUTLET
COOLING OR CITY WATER



Established 1891 **THE POWERS REGULATOR CO.** OFFICES IN OVER 50 CITIES

Bowling 'em over
AT BOWLING GREEN

POWER FOR GENERATOR is supplied by International UD-18A in left foreground, while its twin brother powers the primary crusher.

THE SECONDARY CRUSHER gets its power from a third UD-18A shown in right background.

Gary Brothers, Bowling Green, Kentucky, turn out 100 tons of crushed rock per hour, helped by three International UD-18A's

When Gary Brothers planned and equipped their new mill near Bowling Green, Kentucky, they went a hundred per cent International for cost-cutting economy and long-lasting dependability.

Now they're bowling 'em over with production —100 tons of crushed rock per hour.

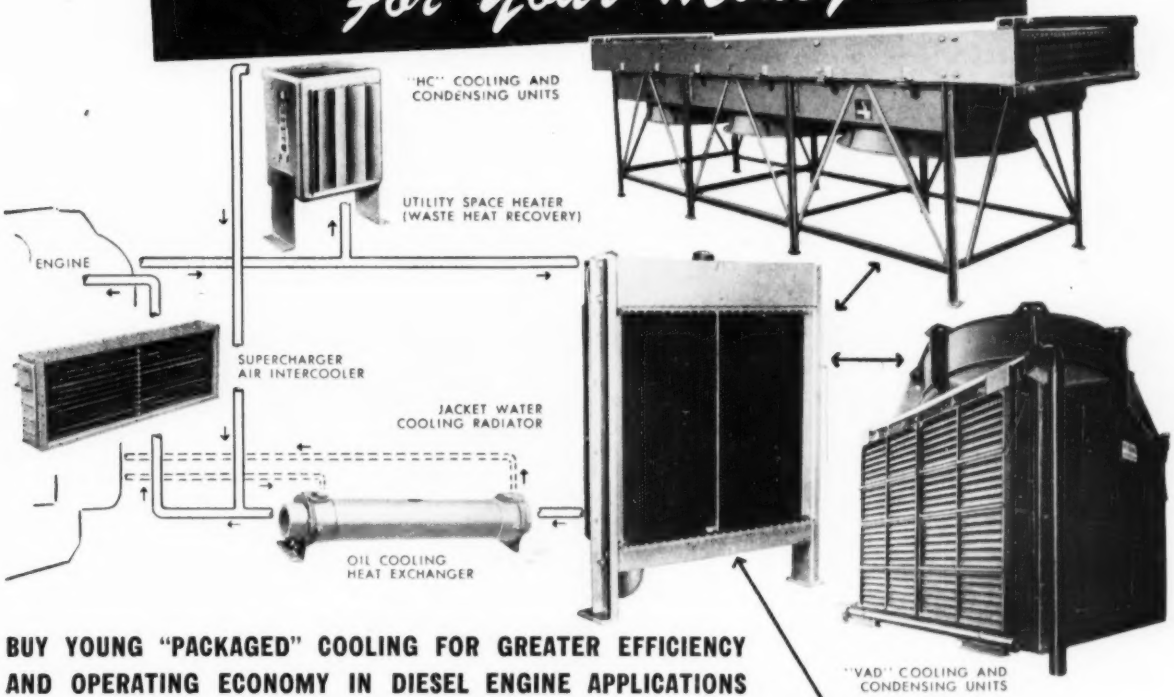
International UD-18A's power the generator, the primary crusher, and the secondary crusher. Gary Brothers also operate a shovel and compressor, both International-powered, and their trucks are Internationals, too.

You can't beat International Power for real performance on your operation. Let your International Industrial Distributor or Power Unit Dealer prove it to you.

INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILL.

INTERNATIONAL INTERNATIONAL HARVESTER **POWER THAT PAYS**

How to Get the MOST HEAT TRANSFER For Your Money

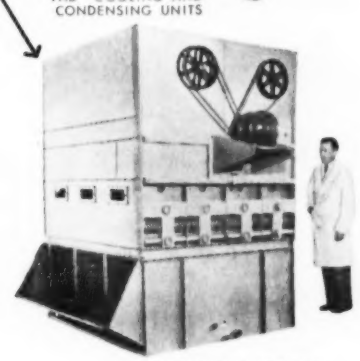

"HC" COOLING AND CONDENSING UNITS
UTILITY SPACE HEATER (WASTE HEAT RECOVERY)
ENGINE
SUPERCHARGER AIR INTERCOOLER
JACKET WATER COOLING RADIATOR
OIL COOLING HEAT EXCHANGER
"VAD" COOLING AND CONDENSING UNITS

BUY YOUNG "PACKAGED" COOLING FOR GREATER EFFICIENCY AND OPERATING ECONOMY IN DIESEL ENGINE APPLICATIONS

If you use one or more of the heat transfer products illustrated above, you will find it pays to specify "Young" right down the line.

Young offers you a balanced cooling system in which every product is designed, built and rated to *work together* for maximum efficiency and economy of operation. For example, a Young Cab Heater can utilize waste heat from engine jacket water for warming cabs or room interiors. There is no chance that a radiator or heat exchanger can be over- or under-rated when the complete system is engineered by one department for your specific requirement.

Why not profit from the convenience and economy of single-source ordering? Make that source Young. The coupon, below, will bring further product information and the name of your nearest Young Representative.



EVAPORATIVE COOLING AND CONDENSING UNITS

YOUNG

Heat Transfer Products for Automotive and Industrial Applications.

Young Quality

Reg. U. S. Pat. Off.

Heating, Cooling, Air Conditioning Products for Home and Industry.

YOUNG RADIATOR COMPANY

Dept. 411-D RACINE, WISCONSIN
Plants at Racine, Wisconsin and Mattoon, Illinois

COUPON BRINGS DETAILS ON YOUNG PRODUCTS

YOUNG RADIATOR COMPANY
Department 411-D
Racine, Wisconsin

Please send information on the Young Products checked below; also name and address of your nearest representative.

- ☐ Supercharger Intercoolers
- ☐ Utility Space Heaters
- ☐ Heat Exchangers
- ☐ Jacket Water Cooling Radiators
- ☐ "HC" Cooling and Condensing Units
- ☐ "VAD" Cooling and Condensing Units
- ☐ Evaporative Cooling and Condensing Units

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

World-wide service facilities for World-finest fuel injection equipment

When diesel engines go abroad there must be service facilities at the other end to give them specialist attention. C.A.V. maintains a world-wide network of service agents or depots, with finely-trained mechanics or special-tool equipment for this purpose. You can be sure there's an official service station to meet the maintenance needs of vehicles equipped with C.A.V. Fuel Injection Equipment in every part of the globe.

C.A.V. Fuel Injection and Electrical Equipment

Service Depots throughout the world

C.A.V. DIVISION OF LUCAS ELECTRICAL SERVICES INC., NEW YORK 19, N.Y. SALES OFFICE: 14820 DETROIT AVE., CLEVELAND 7, OHIO

174-345A

STANDARD ENGINEER'S REPORT

DATA

LUBRICANT RPM Delo Oil R.R.

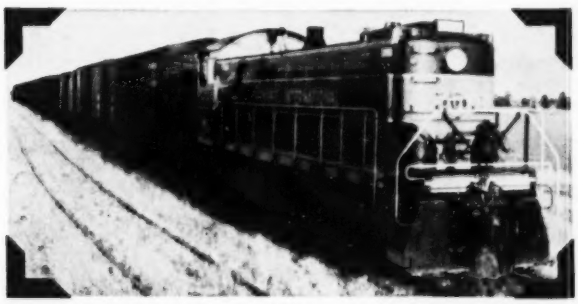
UNIT Alco Diesel – 6 cyl. 12½" × 13" – 1000 H.P.

SERVICE Mountain haul – Heavy snow, extreme cold

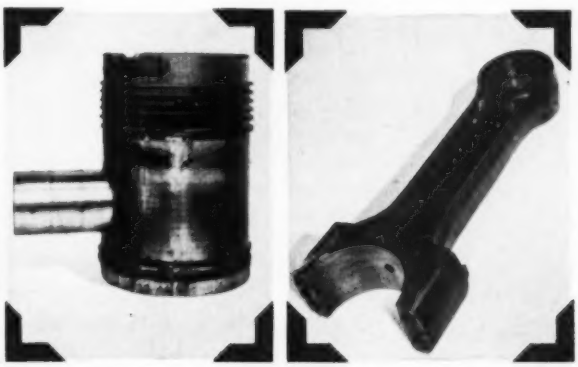
LOCATION Spokane, Wash.–Yahk, B.C.

FIRM Spokane International R.R. Co.

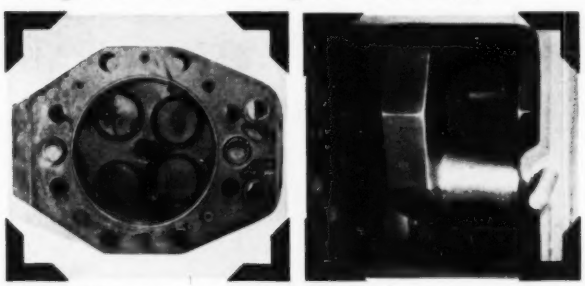
Engines in "perfect condition" after year of toughest service!



LUBRICATED WITH RPM DELO Oil R.R., nine new diesels owned by the Spokane International R.R. Company were kept in regular service for one year. The winter was exceptionally severe and the locomotives bucked heavy snow almost daily. They worked or were idled in temperatures that often for periods of ten days averaged from 20 to 40 degrees below zero.



On inspection at the end of that time there were no accumulations of sludge in oil systems and the engines were in "perfect condition" as pictures of parts from one of them indicate.

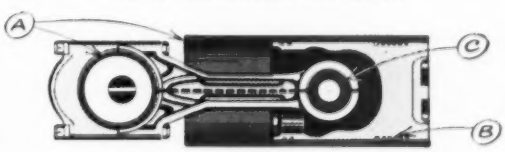


NO CARBON had collected on the cylinder head and all rings were free and functioning properly. Connecting-rod and main bearings and wristpin were within standard tolerance. Measurement of the liner showed less than 0.001 inch wear.

REMARKS: The Spokane International Railroad provides an important connecting service between transcontinental lines through Spokane and the Canadian Pacific to the north. Most of their trackage is in northern Idaho where severe weather and other conditions often make operation difficult. RPM DELO Oil R.R. will meet the toughest weather or operational conditions in all locomotive diesel engines.

RPM DELO LUBRICATING OILS

How RPM DELO Oil R.R. prevents wear, corrosion, oxidation



A. Special additive provides metal-adhesion qualities . . . keeps oil on parts whether hot or cold, running or idle.

B. Anti-oxidant resists deterioration of oil and formation of lacquer . . . prevents ring-sticking. Detergent keeps parts clean . . . helps prevent scuffing of cylinder walls.

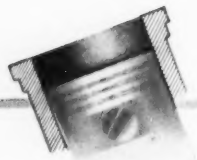
C. Special compounds stop corrosion of bushing or bearing metals and foaming in crankcase.

FOR MORE INFORMATION about this or other petroleum products of any kind, or the name of your nearest distributor handling them, write or call any of the companies listed below.

TRADEMARK "RPM DELO" REG. U.S. PAT. OFF

STANDARD OIL COMPANY OF CALIFORNIA • San Francisco
THE CALIFORNIA OIL COMPANY • Barber, N.J., Chicago, New Orleans
STANDARD OIL COMPANY OF TEXAS • El Paso, Texas
THE CALIFORNIA COMPANY • Denver, Colorado

Beat Wear...



GUN IRON CAST PARTS

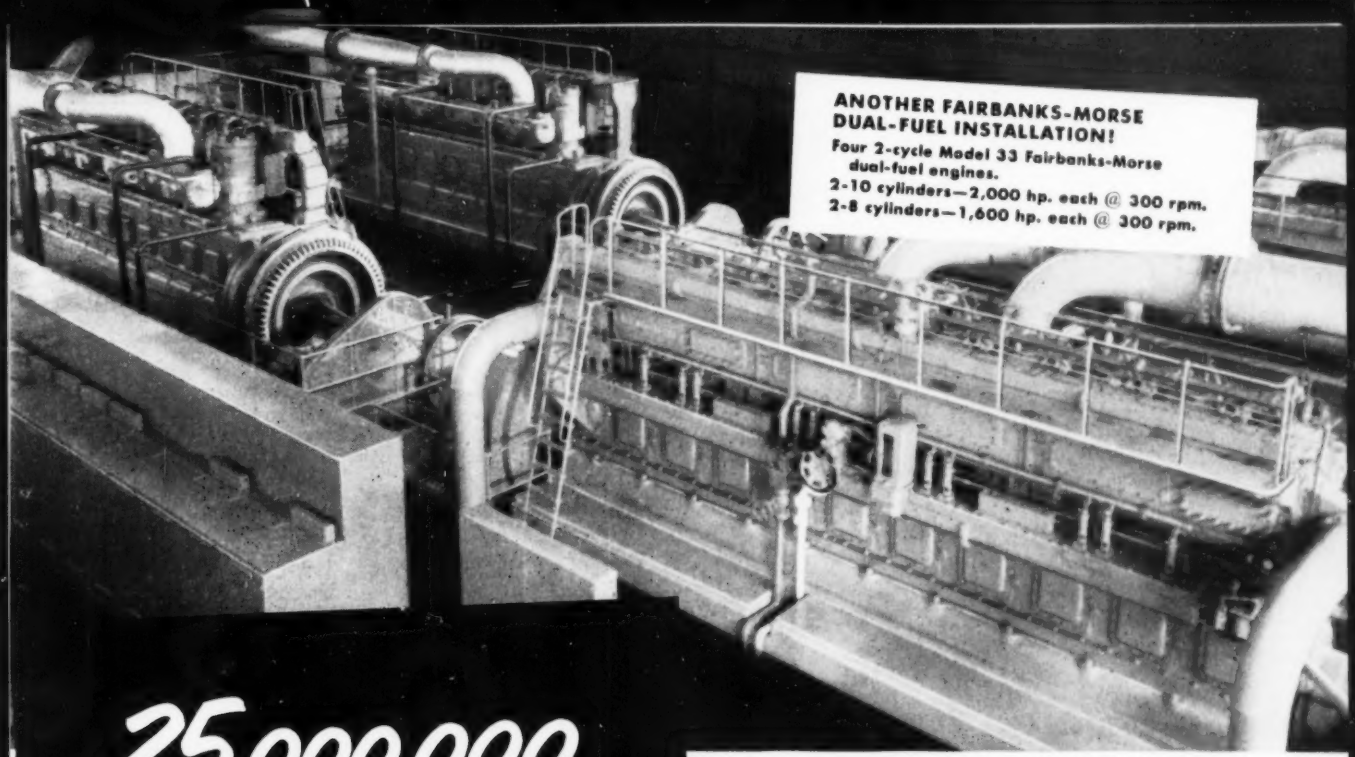
It will pay you to investigate Gun Iron for cast parts subjected to frictional wear. Gun Iron's dense, close-grained, microstructure is 100% pearlite with an even distribution of flake graphite throughout and has proven more resistant to wear in literally thousands of applications.

Hunt-Spiller regularly produces wearing parts of Gun Iron such as cylinder liners, rings and pistons for leading diesel manufacturers and operators. These customers have seen the operating economy of Gun Iron in service. Further, they have found they can rely on the dependable accuracy of Hunt-Spiller's manufacturing department.

Gun Iron's resistance to frictional wear as well as heat, pressure and erosion may prove valuable for *your* parts. Our engineers and laboratories stand ready to help you determine its specific advantages. Call on them. **HUNT-SPILLER MANUFACTURING CORP., 373 Dorchester Ave., Boston 27, Mass.**

Canadian Representatives: Jos. Robb & Co., Ltd., 4050 Namur St., Montreal 16, P.Q.;

***HERE IS A PRACTICAL GUIDE** for the user of iron and steel castings . . . 24 pages of technical data on many types of metals and alloys. Write for your free copy.*



ANOTHER FAIRBANKS-MORSE DUAL-FUEL INSTALLATION!

Four 2-cycle Model 33 Fairbanks-Morse dual-fuel engines.
2-10 cylinders—2,000 hp. each @ 300 rpm.
2-8 cylinders—1,600 hp. each @ 300 rpm.

25,000,000 LOW COST Kw-h per YEAR with FAIRBANKS-MORSE DUAL FUEL POWER!

The basic and important economies of Fairbanks-Morse dual-fuel engines are amply evident in the first year's record of this 7200 hp. installation. Here are a few facts that should interest anyone who wants low-cost, unfailing power generation.

Plant requirements of 5600 hp. are met with three engines running at full load, one held in reserve . . . units in operation must run at an overload before the operator starts up another engine . . . frequently, electrical equipment is started across the line, pulling an estimated 500% overload . . . in one year there has not been a single shutdown due to engine failure . . . in six months the engines ran a combined total of 13,816 hours out of a possible 17,520 . . . engines can operate either as full diesels or on natural gas and can be switched instantly from one fuel to the other.

Look over these facts—then look into the matter of gaining the economies of dual-fuel operation in *your* plant. When you do, remember that there are more Fairbanks-Morse dual-fuel installations than any other—that Fairbanks-Morse has more dual-fuel experience—and that field conversion parts are available for many sizes and types of Fairbanks-Morse diesel engines. Write your nearest Fairbanks-Morse branch office or Fairbanks, Morse & Co., 600 South Michigan Avenue, Chicago 5, Illinois.

Look at this Six Months Performance Record!

1950	Kw-h Generated	Gas, MCF	Cu. ft. gas per kw-h	Fuel oil (Gals.)	Engine #1 2000 hp.	Engine #2 1600 hp.	Hours #3 2000 hp.	Hours #4 1600 hp.	Lube Oil (Gals.)	Hp. hrs. per gal lube
JULY	2,305,100	25,505	11.06	15,489	682	597	606	530	984	4,450
AUG.	1,931,300	21,814	11.29	13,235	568	503	503	558	831	4,613
SEPT.	2,116,800	22,507	10.63	15,698	613	539	642	525	891	4,709
OCT.	2,174,900	23,769	10.92	15,300	607	576	577	587	894	4,741
NOV.	1,913,800	21,225	11.09	15,909	538	578	449	584	931	4,117
DEC.	2,333,800	25,157	10.73	18,596	666	517	656	615	891	5,000
Total	**12,775,700**	**139,977**		**94,227**	**3,674**	**3,310**	**3,433**	**3,399**	**5,422**	**4,601**

FAIRBANKS-MORSE,
a name worth remembering

DUAL-FUEL AND DIESEL ENGINES • "ZC" ENGINES • PUMPS
ELECTRIC MOTORS • LIGHT PLANTS • GENERATORS • SCALES

A NATION-WIDE AUTHORIZED SERVICE ORGANIZATION

DIRECTORY OF SERVICE STATIONS IN U. S. A.

ARIZONA
Phoenix, Charlie C. Jones Battery & Elec. Co., 318 West Jefferson St.

CALIFORNIA
Los Angeles 21, Magneto Sales & Service Co., 751 Towne Ave.
Sacramento, Langner & Rifkin, 1116 Fifth Street.
San Diego 1, Magneto Sales & Service Co., 1254 Kettner Blvd.
San Francisco 3, Furrer & Uster, Inc., 225—7th St.
San Francisco 3, H. G. Makelim Magneto Repair Co., 1583 Howard Street
Wilmington, Diesel Control Corporation, 218 North Marine Ave.

COLORADO
Denver 3, Central Supply Co., 1171 Lincoln Street

FLORIDA
Jacksonville 1, Spencer Electric Co., Inc., 40 West Beaver Street
Miami 36, Florida Diesel Service Co., 1930 North Miami Ave.

GEORGIA
Atlanta 3, Auto Electric & Magneto Co., 477 Spring Street, N. W.

ILLINOIS
Chicago 16, Illinois Auto Electric Co., 2011—37 Indiana Ave.

INDIANA
Indianapolis, Gulling Auto Electric Inc., 450 North Capital Ave.

IOWA
Cedar Rapids, Edwards Carburetor & Electric Co., 209 Seventh St., S. E.
Des Moines 9, Electrical Service & Sales Co., 1313 Walnut Street

LOUISIANA
New Orleans 13, John M. Walton, Inc., 1050 Carondelet Street
Shreveport, Vaughan Tractor & Auto Parts Co., 224 Airport Drive

MARYLAND
Baltimore 1, Parks & Hull Automotive Corp., 1033 Cathedral Street

MASSACHUSETTS
Boston 15, W. J. Connell Co., 121 Brookline Ave.

MICHIGAN
Detroit 2, Knorr-Maynard, Inc., 5743 Woodward Ave.

MINNESOTA
Minneapolis 2, Reinhard Bros. Co., Inc., 11 South 9th Street

MISSOURI
Kansas City 8, Electrical & Magneto Service, Inc., 2538 Grand Ave.
St. Louis 23, Diesel Fuel Injection Service Co., 9331 South Broadway

NEBRASKA
Omaha 2, Carl A. Anderson, Inc., 16th and Jones Street

NEW JERSEY
Newark 2, Tire Trading Co., 239 Halsey Street

NEW YORK
Brooklyn 16, E. A. Wildermuth, Inc., 1102 Atlantic Ave.
Brooklyn 32, A & D Diesel Service, Inc., 677 Fourth Ave.
Buffalo 8, Hettrich Electric Service, 1032 Ellicott St.
Syracuse 4, F. A. Crossman, Inc., 943 Genesee St.
Troy, Ehrlich Electric Service, Inc., 200 Fourth Street

OHIO
Cleveland 14, Cleveland Ignition Co., 1301 Superior Ave., N. E.

OKLAHOMA
Tulsa 3, Magneto Ignition Co., 701 West 5th Street

OREGON
Portland 14, Automotive Products, Inc., 1700 Southeast Grand Ave.

PENNSYLVANIA
Philadelphia 32, J. W. Parkin, Jr., 2251 North Broad Street
Pittsburgh 13, Automotive Ignition Co., 6358 Penn Ave.

TENNESSEE
Memphis 4, Automotive Electric Service Co., 982 Linden Ave.

TEXAS
Dallas 1, Beard & Stone Electric Co., 2101 Bryan St.
El Paso, Oakes Battery & Electric Co., 423 Texas Street
Houston 1, Beard & Stone Electric Co., Milam at Polk Street
Houston 11, Magneto & Diesel Injector Service, 6931 Navigation Blvd.
Odessa, Electric Service & Supply, 1601 North Grant Street

VIRGINIA
Norfolk, Diesel Injection Sales & Service, 710 Union Street
Richmond 20, Charles H. Woodward Electric Co., 709 Broad Street

WASHINGTON
Seattle 1, Seattle Injector Co., 2706—2nd Ave
Seattle 14, Sunset Electric Co., 300 Westlake, North
Spokane 8, Sunset Electric Co., 1st and Adams St.

WISCONSIN
Milwaukee 2, Wisconsin Magneto Co., 918 North Broadway

CANADA
Quebec—Montreal—International Electric Co., 1037 Bleury St.
British Columbia—Vancouver—Magneto Sales & Service, Ltd., 126 Gore Ave.

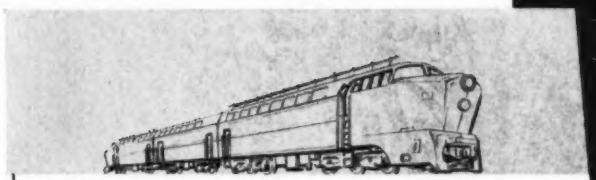
Bendix

FUEL INJECTION EQUIPMENT

SCINTILLA MAGNETO DIVISION of
SIDNEY, NEW YORK

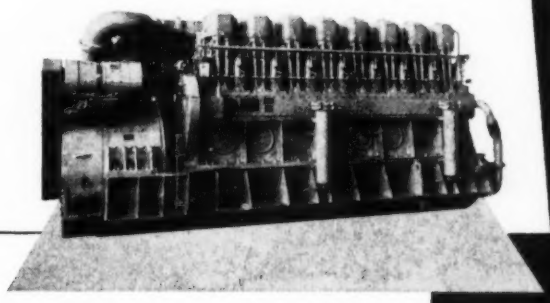
Bendix AVIATION CORPORATION

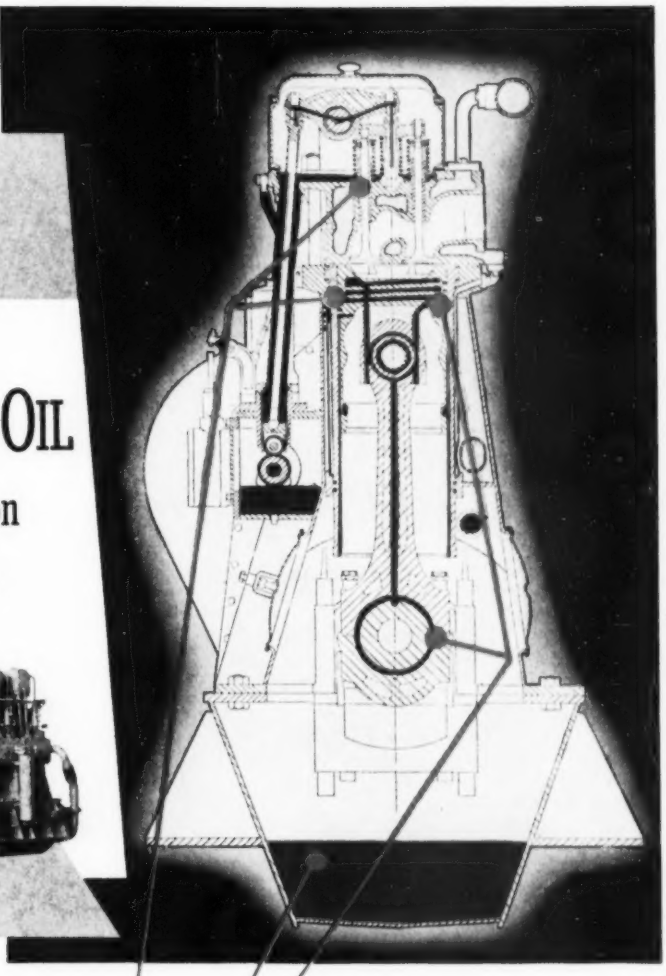
Western Office: 582 Market Street, San Francisco 4, California
Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.



GULF DIESELMOTIVE OIL

provides better lubrication for Diesel Locomotives





Section drawing through piston and cylinder of an 8-cylinder locomotive Diesel engine, rated 1500 bhp at 625 rpm.

effective detergency **-keeps engines cleaner**

lasts longer **-extends oil change period**

provides better protection **-insures less wear, lower maintenance costs**

GULF Dieselmotive oil provides the kind of lubrication that means higher availability and lower maintenance costs for railroad Diesel locomotives.

The effective detergent action of this quality lubricating oil prevents deposit of sludge- and varnish-forming materials — keeps piston rings and valve stems free, helps you avoid cylinder head changes.

Gulf Dieselmotive Oil has outstanding resistance to oxidation and sludging, maintains a low neutralization number. You also make a saving in lubricant costs because Gulf Dieselmotive Oil lasts longer. And it is noncorrosive to alloy bearings.

Diesel locomotives in both main line and switching service are setting maintenance records with Gulf Dieselmotive Oil that are hard to beat. To get the advantage of this outstanding Diesel lubricating oil in your engines, call in a Gulf Lubrication Engineer today. Write, wire, or phone your nearest Gulf office. Gulf Oil Corporation · Gulf Refining Company, Gulf Building, Pittsburgh, Pennsylvania.

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1901 GULF 1951
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SELF-SEALING COUPLINGS

Aeroquip provides the fastest, most economical method known for disconnecting and reconnecting charged, fluid-carrying lines. One coupling takes the place of two hand-operated valves. It reduces downtime for service and maintenance and permits speedy interchangeability of accessories. Used with water, hydraulic fluid, oil, diesel fuel, gasoline and refrigerant gas lines.

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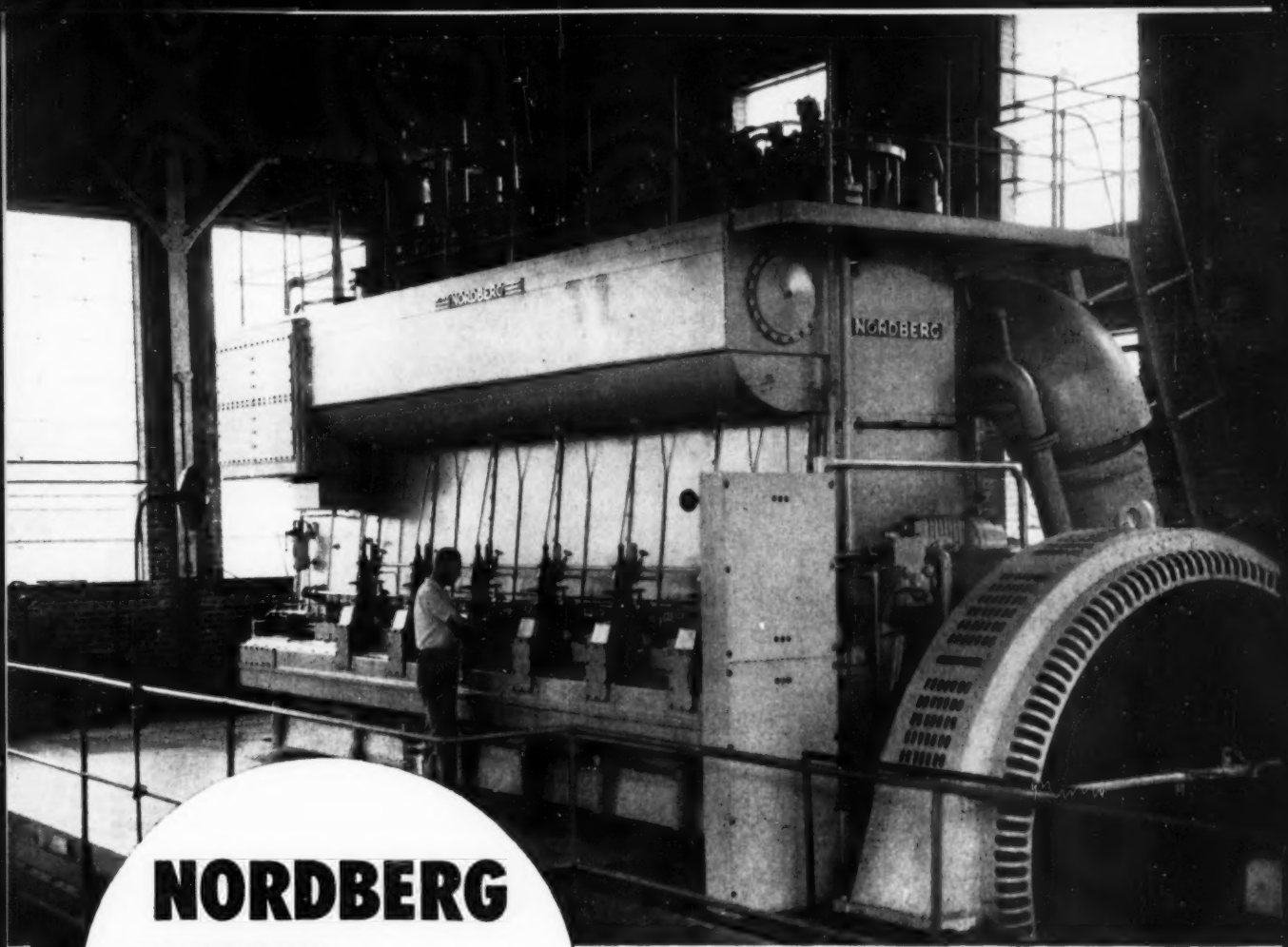
AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U. S. A. AND ABROAD



NORDBERG DIESEL *saves* $100,000 *a year!*

HARRISONBURG, VIRGINIA, CUTS GENERATING COSTS IN DIESEL-STEAM-HYDRO SYSTEM WITH 2400 H.P. DIESEL BURNING ECONOMICAL NO. 5 FUEL . . .

FROM 1904 to 1923, the city of Harrisonburg, Va., relied on hydro electric power entirely. In 1923, a new steam plant was put in operation to meet the city's growing power requirements. In 1949, a 2400 h.p. Nordberg Diesel was installed to handle the rapidly expanding load and to reduce power generating costs.

This Nordberg two-cycle unit, driving a 1690 kw generator, is saving Harrisonburg $100,000 a year as compared with steam generating costs, and has become the major power producer in the city's diesel-steam-hydro system. The Diesel is operating 24 hours a day and producing at the rate of 10,000,000 kw. hrs. a year. Burning an economical No. 5 fuel oil, its record has been so impressive that the city council has voted to expand the Diesel plant and abandon steam as a regular source of power.

Here, then, is an outstanding case study of the way in which Nordberg Diesels can cut power costs. Write for further information on Nordberg two and four-cycle oil burning and Duafuel Diesels and gas burning engines to meet your specific power needs . . . sizes from 10 to 9600 h.p.

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DIESEL ENGINES

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diesel equipment

● The result of Auto-Lite's 40 years of automotive electrical experience, Auto-Lite Diesel systems are complete from generator to voltage control to battery to starter. The dependability of Auto-Lite electrical units in service has made Auto-Lite the world's largest independent manufacturer of automotive electrical equipment. Engineers and executives are invited to consult with us on Diesel cranking and generating equipment.

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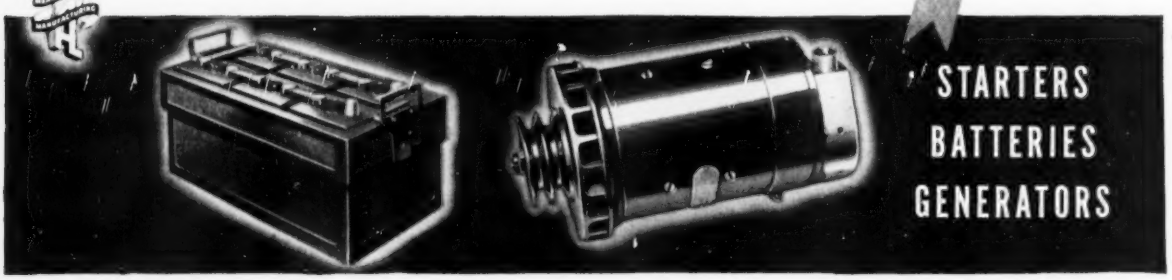
Money cannot buy better diesel equipment . . .



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IN ALL TYPES OF DIESELS!

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MOTOR OIL

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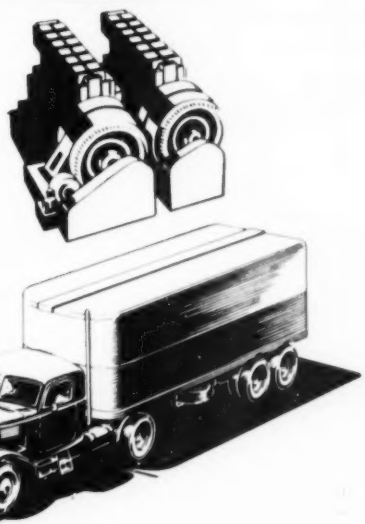
STANDS UP LONGER!

The reason is Extrinol, the "extra" that gives D-X DHD higher resistance to heat, foaming and sludge formation. Try D-X DHD on a money-back guarantee.

The D-X line of industrial lubricants includes a product for every need. If you are located in the Middle West, ask for the services of a D-X Lubrication Engineer in helping solve your lubrication problems. You will not be obligated in any way.



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POWERHOUSES of EFFICIENCY...

AC GENERATORS
20 KW through 150 KW at 1200 RPM
20 KW through 200 KW at 1800 RPM

DELCO GENERATORS

When you consider the low annual cost and high efficiency of a Delco generator you will know why they are favored by engine manufacturers and assemblers. Low cost per year for long service operation—plus the many advantages of design and construction—has given Delco generators their reputation for dependability and efficiency. Many of their features of construction and items of equipment . . . often classed as *extras* . . . are *standard* with Delco. And they pay off handsomely for the ultimate owner.

Power range of Delco generators for engine-driven stand-by and portable equipment is from 20 through 200 KW—AC and DC—1200, 1500 and 1800 RPM. Any of the sales offices listed below will be glad to supply detailed information.

DC GENERATORS
20 KW through 90 KW at 1800 RPM
20 KW through 75 KW at 1500 RPM
20 KW through 60 KW at 1200 RPM

DELCO
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DELCO GENERATORS

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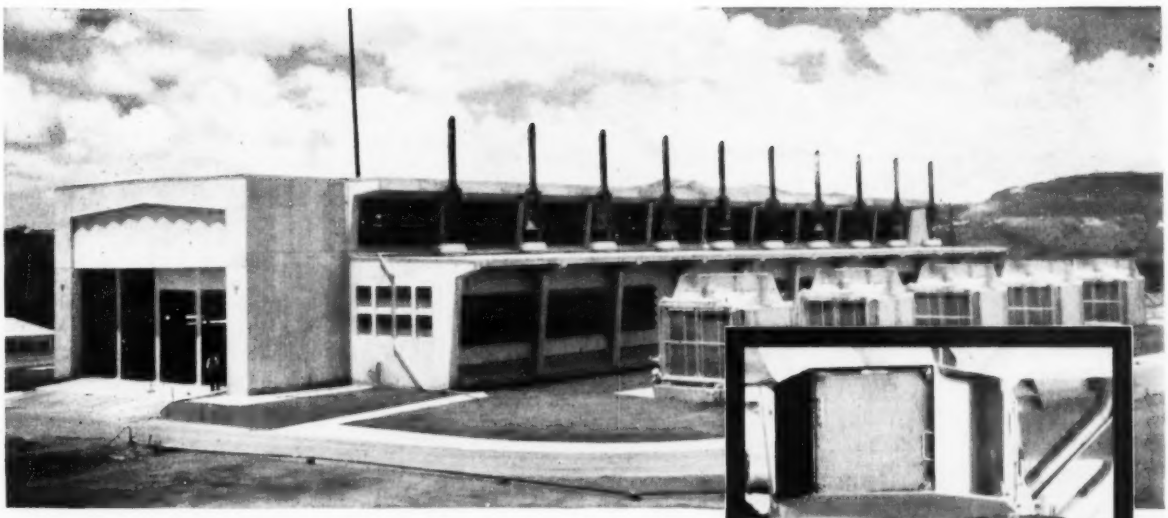

NAVY *Scuttles Dust* with AAF Filters

Type "OC-H" FILTERS Provide Defense For Twenty Diesel Generators On Guam

Since 1948 the Navy has consolidated its scattered power generation operations on Guam with the installation of two 10-generator stations. Main illustration above shows exterior view of the modern station at Agana. Inset shows interior view of the duplicate installation at Orote and the AAF Type "OC-H" Filters which are installed on the air intake of each 1000 hp Diesel generator.

Dust is the sworn enemy of such equipment and, if given the opportunity, can quickly lead to permanent damage, costly repairs and untimely shutdowns. With AAF Filters standing 24-hour guard, these engines are safe. The type "OC-H" is a low cost, washable, unit-type filter which offers low resistance to air flow, high cleaning efficiency and large dust-holding capacity.

Whether your operations are located in a desert, dust bowl or industrial district, AAF has a filter of a type and capacity that will provide positive dust protection for your engines or compressors. Write today for complete catalog information.

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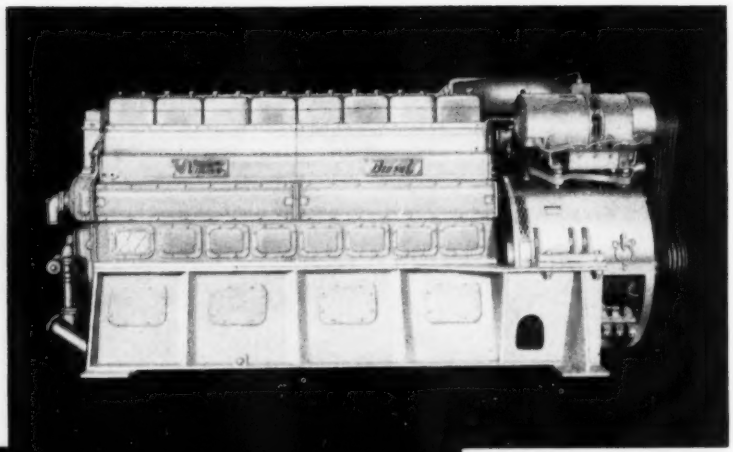
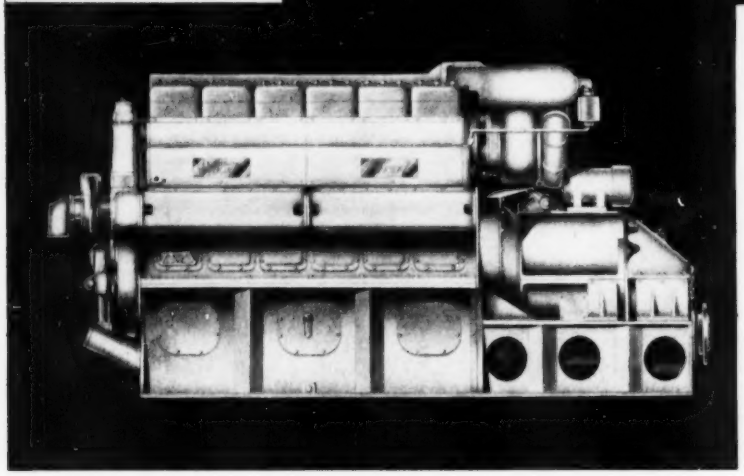




ABOVE

Sterling Viking Diesel 8 cylinder generator set rated at 600 KW.

LEFT

Sterling Viking Diesel 6 cylinder marine engine with reverse gear, rated at 665 HP in continuous service.

●

Descriptive bulletins on these and other Sterling Viking Diesel engines from 150 to 1000 BHP will be sent on request.

POWER to move ships and trains, to operate machinery or to light airports, means much more than merely installing an engine.

Fifty years of experience...broad and successful experience in applying power to just about every conceivable use is one of the reasons why Sterling engines are held in such high regard the world over.

Engineering progress is a second reason for Sterling preference. The best evidence of what constitutes success in engine design and performance is when customers come back for more.

We have the present day orders, facts and figures to show every marine and industrial user of power that Sterling's first 50 years marks just the beginning. *Talk to a Sterling Engineer.*

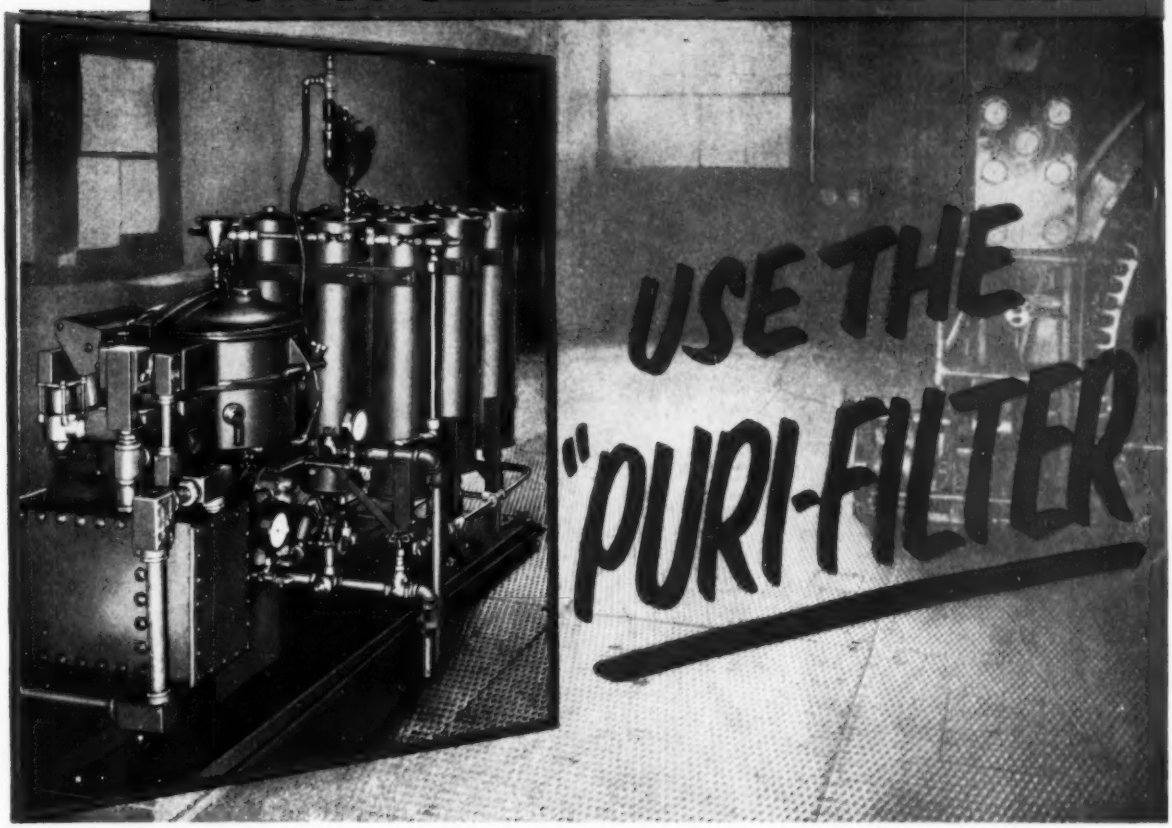
Sterling

MARINE AND INDUSTRIAL ENGINES

● Depend upon Sterling Diesel Power for Locomotives, Generator Sets, Commercial and Fishing Craft, Lift Bridges, Ventilating Systems, Drilling Rigs, Etc.

STERLING ENGINE COMPANY • 1270 Niagara Street • Telephone Lincoln 0382 • Buffalo 13, New York

FOR A CLEANER CRANK CASE-



A clean crank case is a direct reflection of clean lubricating oil. Crank cases of engines whose lubricating oil is purified by a De Laval "Puri-Filter" remain remarkably clean even after long periods.

The answer lies in the dual cleaning ability of the "Puri-Filter." First, the De Laval Oil Purifier removes solid impurities and water by removing them from the oil by centrifugal force. Then the partially purified oil passes through the filters which get rid of colloidal material that is lighter than the oil itself. The result is lubricating oil that is ***visibly*** free of impurities.

The "Puri-Filter" is a compact unit, furnished completely piped up, ready to run, and in capacities to fit every size diesel plant.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
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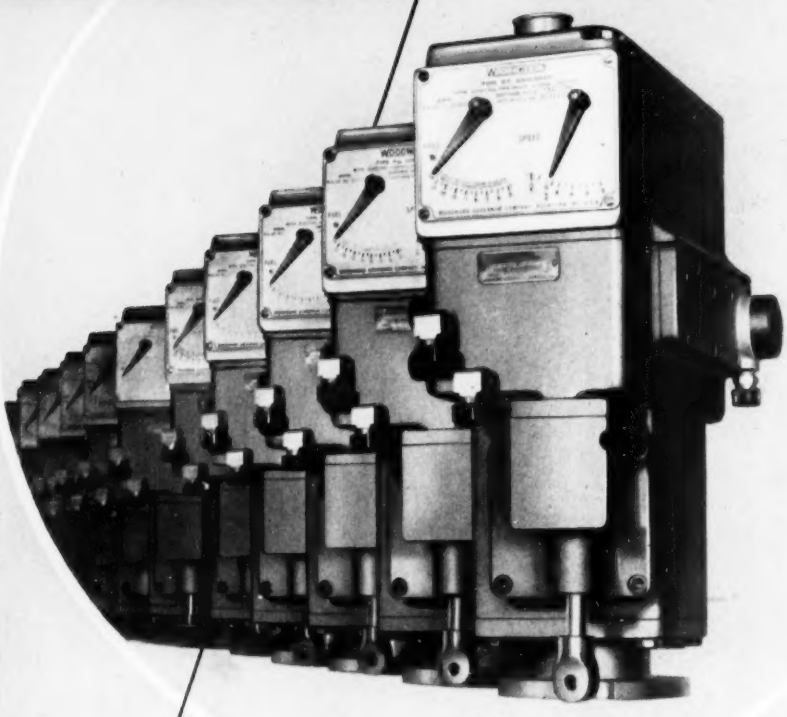
DE LAVAL OIL PURIFIERS
FOR DIESEL LUBRICATING OIL

WOODWARD

TYPE PG HYDRAULIC GOVERNORS



The precision Type PG Governor is adaptable to practically all "special service" internal combustion engine applications. Versatility is obtained by fitting appropriate auxiliary devices to the basic standard PG Governor. These auxiliary devices include electrical and pneumatic remote control equipment, torque limiters, standard air instrument motors for process control applications, pressure controls and almost any other means for biasing the normal speed control function.

WOODWARD GOVERNOR COMPANY ROCKFORD ILLINOIS

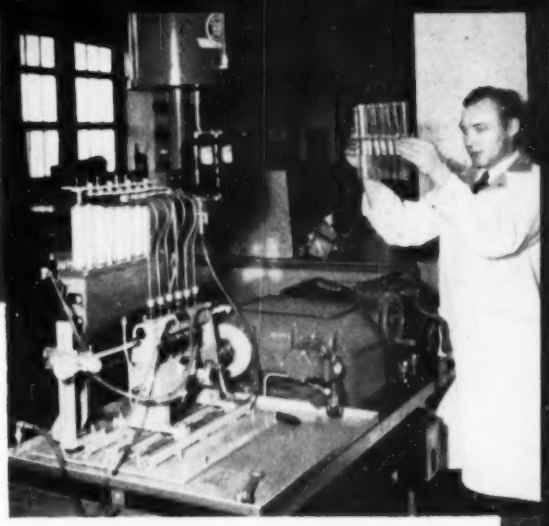
World's oldest and largest exclusive manufacturer of hydraulic governors for prime movers.

80 WOODWARD SERVICE

competent, dependable

FUEL INJECTION SERVICE

for AMERICAN BOSCH-equipped diesels



CRAFTSMANSHIP, PRECISION, KNOW-HOW — typical of American Bosch manufacture — are carried over in full to our ever-growing service organization.

At these authorized American Bosch stations, factory-trained mechanics are constantly kept informed of the latest and most efficient service methods . . . work with test equipment and specialized service tools that are designed and built to factory standards for accurate, reliable servicing.

Complete precision service like this saves time and money for owners of American Bosch equipped diesels . . . helps keep their engines functioning at top-notch efficiency. It's one more reason why *dependable* fuel injection equipment by American Bosch *stays dependable* throughout a long and economical life.

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ARKANSAS—**North Little Rock**, Womack Brothers and Taylor, 522 East Washington.

CALIFORNIA — **Fresno**, Winther Bros., 612 Divisadero St.; **Los Angeles**, Diesel Injection Equipment Co., 4847 Anaheim Telegraph Rd.; **Los Angeles 21**, Magneto Sales & Service Co., Inc., 751 Towne Ave.; **Sacramento 6**, Langner & Rifkin, 1116-22 15th St.; **Salinas**, Haag Diesel Electric, 37 Abbott St.; **San Diego**, Magneto Sales & Service Co., 1254 Kettner Blvd.; **San Francisco 3**, Furrer & Uster, 225 Seventh St.; **Wilmington**, Diesel Control Corp., 218 North Marine Ave.

COLORADO — **Denver 3**, Central Supply Company, 1171 Lincoln St.

DISTRICT OF COLUMBIA—**Washington**, Diesel & Ignition Service, Inc., 925 Girard St., N. E.

FLORIDA — **Jacksonville**, Patten Sales Co., Inc., 1021 Hogan St. **Jacksonville**, Spencer Electric, Inc., 40 West Beaver Street. **Miami 36**, Florida Diesel Service Co., 1930 N. Miami Ave. **Tampa**, Stuart Diesel Service, 3101 4th Ave.

GEORGIA — **Atlanta 3**, Auto Electric & Magneto Co., 477 Spring St., N. W.

IDAHO — **Boise**, Midwest Service & Supply Co., 1208 Grove St. **Lewiston**, Osterman Diesel & Electric Co., 1610 Main St.

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INDIANA—**Indianapolis 4**, Gulling Auto Electric Inc., 450 N. Capitol Ave.

IOWA — **Cedar Rapids**, Edwards Carburetor & Electric, Inc., 209 Seventh St., South-East. **Des Moines**, Electrical Service & Sales Co., 1313 Walnut St.

KANSAS—**Wichita 2**, E. S. Cowie Electric Co., 230 S. Topeka Ave.

KENTUCKY — **Louisville**, Schaaf Auto Electric Co., Broadway at Jackson.

LOUISIANA — **New Orleans**, Gerhardt's Fuel Injection Service, 734 Girod Street. **New Orleans 13**, John M. Walton, Inc., 1050 Carondelet St. **Shreveport**, Vaughn Tractor & Auto Parts Co., 224 Airport Drive.

MAINE — **Portland 5**, Portland Tractor Co., Inc., 803 Forest Ave.

MARYLAND — **Baltimore 1**, Parks and Hull Automotive Corp., 1033 Cathedral St. **Baltimore**, Stephen Seth & Co., 876 Park Ave.

MASSACHUSETTS — **Boston 15**, W. J. Connell Company, 121 Brookline Ave. **Boston 10**, Wharf Machine & Electric Co., Inc., Fish Pier Road. **Fairhaven**, Hathaway Machinery Co., Inc., Hathaway-Braley Wharf.

MICHIGAN — **Detroit**, Knorr-Maynard, Inc., 5743 N. Woodward Ave.

MINNESOTA—**Minneapolis**, George Nusbaum Diesel Service Co., 3157 15th Ave., South. **Minneapolis 2**, Reinhard Bros. Co., Inc., 11 South 9th St.

MISSISSIPPI — **Jackson**, Womack Brothers, 1305 South Gallatin Street.

MISSOURI — **Kansas City 8**, Electrical & Magneto Service Co., 2538 Grand Ave. **St. Louis 23**, Diesel Fuel Injection Service Co., 9331 So. Broadway. **St. Louis 3**, Electric Parts and Service Co., 2900 Washington Blvd.

MONTANA — **Billings**, Original Equipment, Inc., 423 North Broadway.

NEBRASKA — **Omaha 2**, Carl A. Anderson, Inc., 16th and Jones.

NEW JERSEY — **Newark 2**, Tire Trading Company, Inc., 239 Halsey St.

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OKLAHOMA — **Fairview**, Keck Bros. Diesel Service, 322 South Main. **Oklahoma City 2**, American Electric-Ignition Co., 124 N. W. 8th St. **Tulsa**, Magneto Ignition Company, 701 West 5th St.

OREGON — **Klamath Falls**, Diesel & Electric Service, 1950 So. Sixth St. **Pendleton**, Eds Magneto & Diesel Co., S. W. 18th and Court Sts. **Portland 14**, Automotive Products, Inc., 1700 Southeast Grand Ave. **Roseburg**, Diesel Products, 303 East Second Ave., South.

PENNSYLVANIA — **Hazleton**, Penn Diesel Service Co., 27th & N. Church Streets. **Philadelphia**, Sullivan Brothers, 1718 Fairmount Ave. **Pittsburgh 13**, Automotive Ignition Co., Inc., 6358-64 Penn Ave.

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UTAH — **Salt Lake City 2**, Koepsel & Love, 47 East 7th South St.

VIRGINIA — **Norfolk**, Diesel Injection Sales and Service, 808 Union St. **Richmond**, C. H. Woodward Electric Co., Inc., 709 W. Broad St.

WASHINGTON—**Rosalia**, Van's Diesel Electric Co., P. O. Box 560. **Seattle 1**, Seattle Injector Co., 2706 Second Ave. **Seattle**, Sunset Electric Co., 300 Westlake North, P. O. Box 3148. **Spokane**, Sunset Electric Co., North 703 Division St. **Walla Walla**, Industrial Products Co., 610 N. Ninth St.

WISCONSIN — **Milwaukee 2**, Wisconsin Magneto Company, 918 N. Broadway.

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MEXICO—**Ciudad Obregon, Sonora**, Servicio Auto Electrico, S. A., Calle Sinaloa No. 400. **Guadalajara, Jalisco**, Electro Diesel de Occidente, Apartado No. 297. **Mexico, D. F.**, Automoto Servicio S. A., Fray Servando Teresa de Mier 242. **Monterrey, Nueva Leon**, Electro Diesel, S. A., Esq. Avenida Morelos y Zuazua. **Torreon, Coahuila**, Servicio Diesel Electrico, S. de R. L., Guadalupe Victoria No. 216 — Sur. **CUBA** — **Havana**, E. Boyer y Cia., San Jose No. 155, (Service Station at Joaquin Alemay Lopez, Avenida Menocal (Infanta) 1106). **Havana**, Compania Riera, Toro and Van Twistern, S. A., Habana No. 86.

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MAIN LINE OF SUPPLY!

ONE of our country's most important military assets is the fleet of General Motors Diesel locomotive units now in service on the main lines of America's railroads. Railroad demand for this power has increased with the national emergency.

Although General Motors Diesels comprise less than one-sixth of the nation's locomotives, they are hauling 33% of the total freight ton-miles on U. S. railroads today.

As compared to steam engines, Diesels average 64% more ton-miles of work per hour.

They average three times as many hours per day!

Diesels haul longer trains on faster schedules—and require far less time out for maintenance, servicing and refueling. With Diesel power, every train carries more tonnage—reducing traffic congestion on the rails and speeding up release of cars for return loads.

All this has been proved by 16 years of General Motors Diesel performance in main line service. So urgent is the demand for these modern locomotives, we are now building General Motors Diesels as rapidly as our facilities and materials permit—a program that assures American railroads a power task-force without equal for the rapid transportation of food, fuel and munitions.

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Home of the Diesel Locomotive

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Penny-Wise... Pound-Foolish!

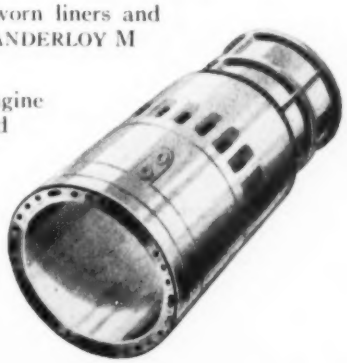
Before PORUS-KROME* and VANDERLOY M, Diesel engines used up liners and crankshafts like Spain used up her income from the New World.

When Spain's supply of gold began to run short, the King sent old DeSoto out to find another Mexico or Peru. With 2,000 followers, he searched the wilderness from Florida to Arkansas. By 1542, nearly all the band had perished and DeSoto's body lay beneath the Mississippi River.

That news made Spain reverse her penny-wise and pound-foolish policy. She began developing the permanent value of her possessions, just as Diesel owners have.

Instead of machining away the bearing diameters of worn liners and crankshafts, they bring them back to original size with VANDERLOY M and PORUS-KROME.

No matter how badly worn, this processing gives such engine parts a longer service life than they had when new. And they can be restored again and again — each time for less than the price of hard-to-get replacements.



**PORUS-KROME is a dense, hard, wear and corrosion-resistant chromium, produced by the Van der Horst Corporation of America, and which gives working surfaces an infinite number of tiny oil-retaining reservoirs for perfected lubrication.*

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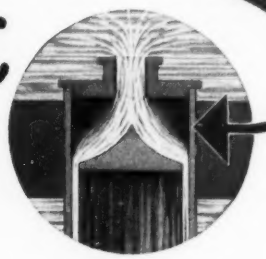
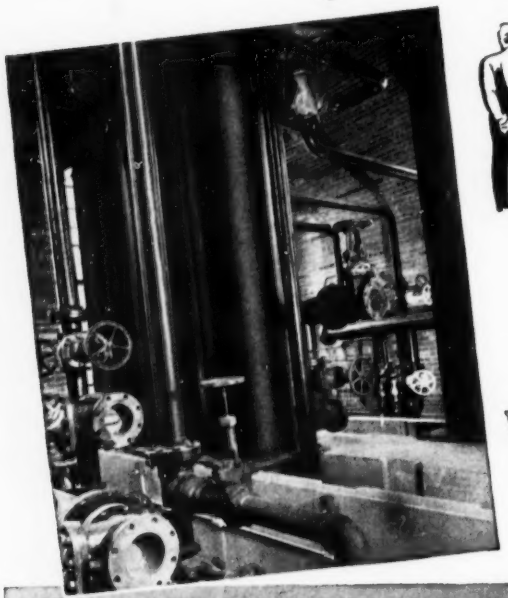
Good for the Life of your Engines

Dirty Water can't "Shut-down"...

Vogt

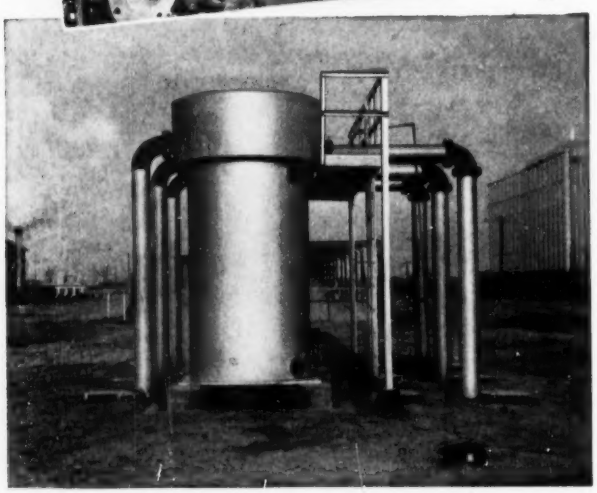




film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424 441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

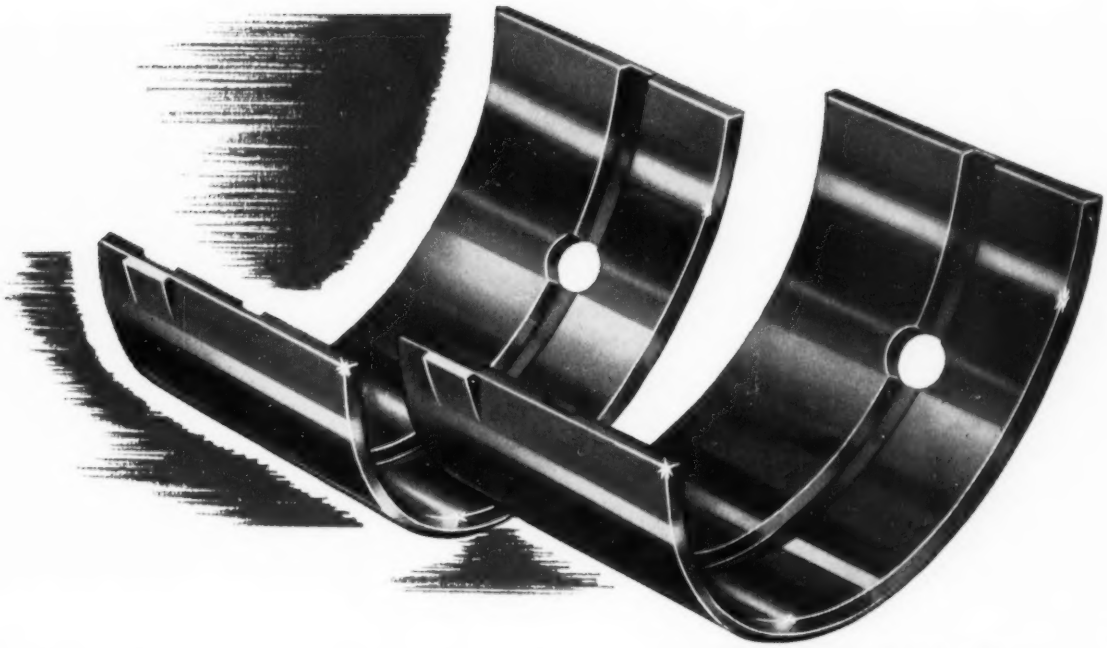
TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.



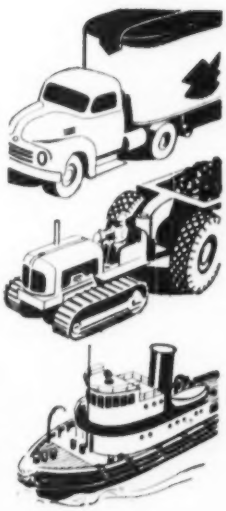
Master Engine Mechanics Prefer MONMOUTH

TODAY'S Diesel power plants in marine, vehicle and stationary use are the finest engines of their type ever built.

Master designers and makers of these fine engines specify and use only top quality components, including CGB bearings of the proper type and construction.

Should bearing replacement become necessary, master engine mechanics maintain the high standard of engine performance with Monmouth Bearings. These bearings are identical in every detail with the original bearings. They excel all others in finish, in precision, in quality and in engineered performance.

In the maintenance of Diesel engines —whether marine, stationary, or in prime movers—specify genuine Monmouth Engineered Bearings.



Monmouth Bearings are engineered and precision made to safeguard the reputation of the master Diesel engine mechanics and to insure user safety and satisfaction.

THE CLEVELAND GRAPHITE BRONZE CO.
REPLACEMENT SALES DIVISION
6545 Carnegie Ave. • Cleveland 3, Ohio

IVAN is watching you

IVAN is a dyed-in-the-wool Communist. There are only 6 million party members like him in all Russia, yet these Communist brass-hats enforce the iron dictatorship of the Kremlin over *200 million* Russians.

He's sold to the hilt on Red ideas. Which means he's out to get *you*. He believes it's either you or him . . . that the world is too small for both.

Ivan is working hard to beat you down. He has a big head start.

Right now he's got you in a bad spot.

Ivan is afraid of only one thing.

He fears your ability to out-produce him in guns, tanks, planes.

Frankly, he doesn't think you value your free system enough to do it . . . to make willingly the sacrifices he has squeezed out of the Russians.

But he's wrong!

Because you and all of us have set out to build more and better weapons—to do it faster all the time.

We must use every bit of know-how and inventive skill we have to improve our machines and methods—to turn out more and more for every hour we work. Only in this way can we become militarily strong.

But we've got to supply essential civilian needs as well. We can't allow needless shortages to take prices skyrocketing and lower the value of our dollar.

Sure, that means sacrifices for everybody. But doing this double job well is the only sure way to stop Ivan in his tracks—and to save the freedoms which are ours and which he has never known.

FREE . . . this important booklet tells you how our American System Grew Great

How Americans developed better machines, power and skills to build a great nation . . . Why we have been able to produce constantly more per hour . . . How this has given us the world's highest living standard.

How we can meet today's challenge—Why we must expand our productive capacity . . . supply arms and essential civilian needs, too. Read how this dynamic process works in free booklet, "The Miracle of America," endorsed by representatives of management and labor. Send for your free copy today!

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This advertisement, approved by representatives of management, labor and the public, is published in the national interest

DIESEL POWER and DIESEL TRANSPORTATION

THE BETTER WE PRODUCE
THE STRONGER WE GROW

P&H DIESEL ENGINES

2-CYCLE

SHOCK LOADS

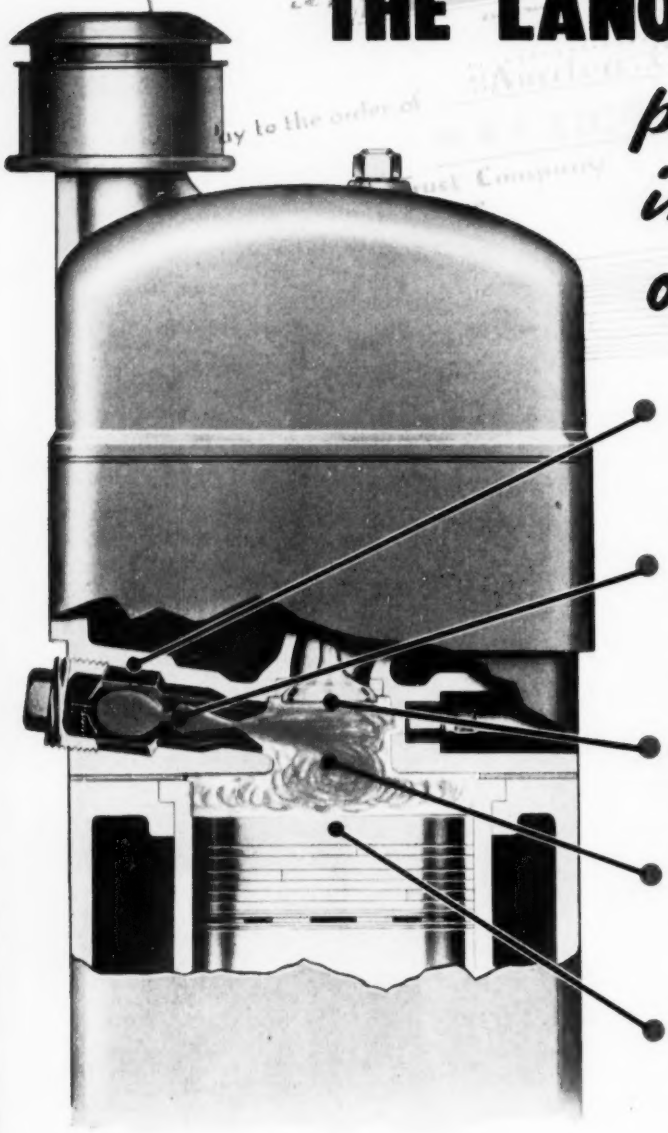
EVERY 30 SECONDS

That's normal operation for power shovels—the toughest assignment known for diesel engines. It's the service P&H Diesels were designed to take. Years of superior performance, attested by hundreds of users, prove that P&H Diesels can take *any* of your toughest jobs in stride. It's one reason wise users are standardizing on P&H Diesels. There are many other reasons worth learning. For literature, write Diesel Division, Harnischfeger Corporation, Port Washington, Wisconsin.

P&H DIESEL DIVISION
HARNISCHFEGER CORPORATION
PORT WASHINGTON WISCONSIN, U. S. A.

THE LANOVA SYSTEM

pays big dividends in high-speed diesel operation!



ISOLATES LIFE-SHORTENING PRESSURE BLOWS

These blows, caused by the rapid rise of combustion pressures, are absorbed in the heavy-walled Lanova energy cell where they can't slam down on and shorten the life of rings, pistons and bearings.

TIMES AND CONTROLS WORKING PRESSURES

The Lanova energy cell has specially designed orifices which control the flow of working pressures back to the piston and time them so that the maximum push is applied at a favorable crank angle and throughout a full degree of the piston power stroke.

KEEPS VALVES FREE AND CLEAN

The Lanova System maintains high combustion efficiencies and lessens the likelihood of exhaust smoke and carbon impairing effective valve seating.

PROVIDES EXTRA FUEL ECONOMY

The Lanova principle of *controlled rotary turbulence* thoroughly mixes fuel with the air needed for full combustion, thus utilizing every drop of fuel to the maximum in producing useful power.

MINIMIZES PISTON AND RING TROUBLES

The blast of hot gases rushing out of the energy cell on the power stroke is directed away from the piston. This means cooler pistons, less ring trouble, and better cylinder lubrication.

THESE ARE JUST A FEW OF THE OUTSTANDING FEATURES OF THE LANOVA COMBUSTION SYSTEM

Compare them—point for point—with any other combustion chamber design and you'll see why Lanova-type diesels pay off in better performance.

What Diesels have the Lanova System?

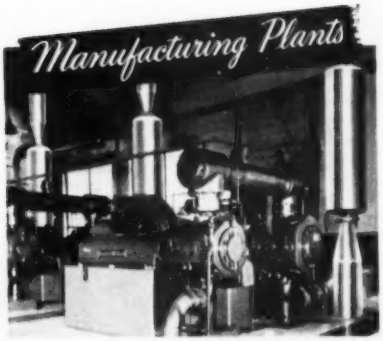
Today, most leading makes of high-speed diesels come equipped with The Lanova Combustion System. We'll be glad to send you the complete list. But, just to be sure—always look for the characteristic Lanova energy cell design.

LANOVA CORPORATION
38-17 30th STREET, LONG ISLAND CITY 1, N. Y.

Lanova... adopted and approved by leading diesel builders

Burgess-Manning Snubbers on gas booster engines at a Louisiana station.

Two Burgess-Manning Exhaust Snubbers installed on this yacht.



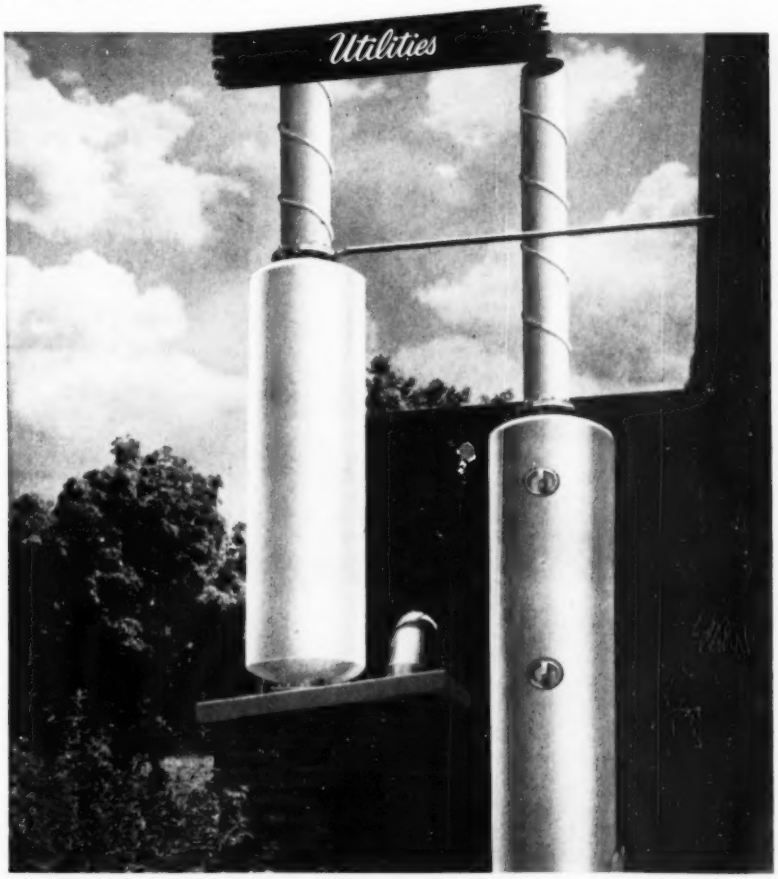
Burgess-Manning Snubbers on compressors at a manufacturing plant.

Reduce Noise

on Engine Exhausts and Compressor Intakes with BURGESS-MANNING SNUBBERS

●

Build Good Will in Plant and Community— Provide Quiet Surroundings... with Burgess-Manning Snubbers



Burgess-Manning Snubbers installed at a Michigan diesel electric power plant.

● Wherever you find an internal combustion engine, compressor, blower, or pump, you will more than likely find a Burgess-Manning Snubber reducing noise . . . building good will for you in your plant and in your community. Burgess-Manning Snubbers smooth the flow of exhaust gases and intake air. High energy "slugs" of exhaust gas are dissipated in successive snubbing stages—the gas reaches the atmosphere in a smooth stream. Incoming pulses of turbulent air to compressors are likewise smoothed to a unidirectional flow. Noise is reduced, vibration is practically eliminated. Metering simplified. Performance of equipment stepped up. Reduce maintenance on engines, compressors, and associated equipment.

For an outstanding solution to your internal combustion engine or compressor noise problem, call in Burgess-Manning engineers, specialists in noise reduction and surge control problems.

BURGESS-MANNING COMPANY **LIBERTYVILLE, ILLINOIS**

"YOU BUY 1 BOX . . . OR 10,000 BOXES . . . AT THE SAME LOW FLAT PRICE PER BRUSH!"

BECAUSE WE'VE STANDARDIZED NATIONAL TRADE-MARK CARBON BRUSHES

FOR DIESEL-ELECTRIC LOCOMOTIVE EQUIPMENT!

YOU PAY the same low, flat price regardless of how many brushes you buy, providing you buy one box or multiple thereof. You get fast delivery because these brushes are kept in stock in large supply. You get better quality because of manufacturing refinements made possible by mass production economies. You get a brand new package — sturdy, attractive, easy to store and handle.

Why is this possible? Because we have STANDARDIZED "NATIONAL" brushes for all motors and generators commonly used on diesel-electric locomotives. We have picked the best brushes in the field for dependable operation under severe and varying conditions. We have made them with top performance grades and still stronger connections — made them better in many ways — and we are now making these brushes in quantity. The list of STANDARDIZED diesel-electric brushes follows:

BRUSH NO.	SIZE (INCHES)	GRADE
	FOR TRACTION MOTORS	
NC 24-7215	2 x 2¼ x ¾ (⅜-⅜)	"Plytek" Grade AZY
NC 24-7213	2 x 2¼ x ¾ (⅜-⅜)	"Plytek" Grade AX-5
NC 24-5620	2 x 1¾ x ¾ (⅜-⅜)	"Plytek" Grade AZY
NC 24-5619	2 x 1¾ x ¾	Grade AX-5
NC 20-6420	2⅛ x 2 x ⅝ (⅛-⅛)	"Plytek" Grade AZY
NC 20-6419	2⅛ x 2 x ⅝ (⅛-⅛)	"Plytek" Grade AJH
NC 32-5204	2¼ x 1⅝ x 1	Grade AX-5
	FOR MAIN GENERATORS	
NC 24-4024	2½ x 1¼ x ¾ (⅜-⅜)	"Plytek" Grade 255
NC 24-4009	2½ x 1¼ x ¾ (⅜-⅜)	"Plytek" Grade SA-45
NC 12-4819	2¼ x 1½ x ⅜	Grade SA-35 (30/30 Bevel)
NC 20-4202	2 5/16 x 1 1/16 x ⅝ (⅛-⅛)	"Plytek" Grade SA-3590
NC 20-5633	2¼ x 1¾ x ⅝ (⅛-⅛)	"Plytek" Grade SA-3590
NC 12-4812		
NC 12-4813	2¼ x 1½ x ⅜	Grade SA-35 (35/10 & 35/30 Bevels)
NC 13-5101	2¼ x 1.580 x .400	Grade AX-5
	FOR AUXILIARY EQUIPMENT	
NC 20-3220	2 x 1 x ⅝	Grade 259
NC 16-3220	1¾ x 1 x ½	Grade SA-3538
NC 16-5622	1¾ x 1¾ x ½	Grade 259
NC 08-3216	1¾ x 1 x ¼	Grade SA-45

The terms "National", "Plytek" and the Three Pyramids Device are registered trade-marks of

NATIONAL CARBON COMPANY • **Division of Union Carbide and Carbon Corporation**

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District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco • In Canada: National Carbon Limited, Toronto 4

DIESEL SERVICE

The ENTERPRISE symbol stands for *SERVICE*

. . . when you need it
. . . where you need it

12 Enterprise service offices, 9 parts warehouses, well stocked with replacement parts, stand ready at an instant's notice to bring prompt and efficient service to Enterprise customers *where and when they need it.*

These facilities are strategically located for quick handling of all routine maintenance and engine overhaul work. And where an unusual emergency requires quick delivery of parts not normally stocked in local warehouses, you can rely on Enterprise's promise of immediate factory shipment. Competent Enterprise Service Engineers are constantly available for supervision of any engine service, routine or otherwise. Their thorough knowledge and experience invariably avoids unnecessary delays and expense, puts engines back to work quickly.

When you specify Enterprise, you can always count on this prompt, expert Enterprise service—where and when *you* need it.

ENTERPRISE ENGINE & MACHINERY CO.
A Subsidiary of General Metals Corporation
18th & Florida Streets, San Francisco 10, California
Offices in Principal Cities

Enterprise Diesels

Automatic ENGINE CONTROLS

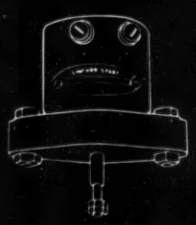
CRANKING CONTROLS

ALARM RELAYS

You can get a SYNCHRO-START Control to meet any Engine Control requirement, for Gas, Gasoline or Diesel engines, no matter what the power application may be, either for FULL AUTOMATIC, SEMI-AUTOMATIC, MANUAL, PROTECTION ONLY, or a COMBINATION of any or all of the control features to meet exactly what you want, or that is needed to fulfill a specific demand.

Nineteen years of manufacturing engine controls, ranging from a simple switch to multiple-engine control panels, have given SYNCHRO-START the "know-how" to make thoroughly DEPENDABLE CONTROLS to meet your needs correctly.

OVERSPEED GOVERNORS



SOLENOIDS

When you order your engines—SPECIFY SYNCHRO-START Controls. Your manufacturer, dealer, engineering firm, or architect can furnish you with the correct control. Or write us direct for our nearest representative.

SYNCHRO-START PRODUCTS, INC.

8151 N. RIDGEWAY AVE. • SKOKIE, ILLINOIS

YOU GET ALL 3—

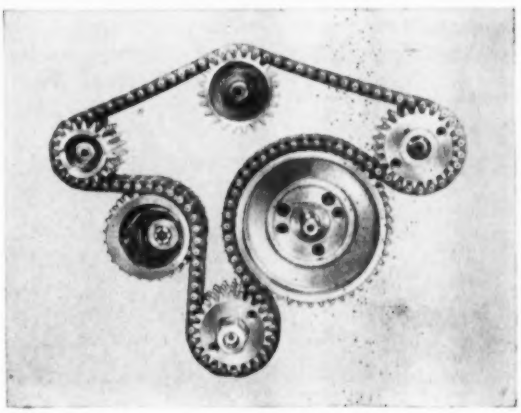
- AUTOMATIC JOINT SNUGNESS
- SMOOTHER OPERATION
- GREATER DESIGN FLEXIBILITY

...when you use LINK-BELT ...the world's finest timing chain from the world's largest chain plant

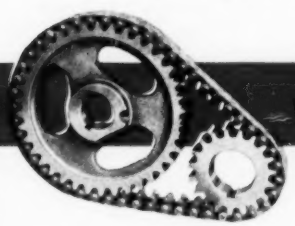
YES, you get superior performance . . . greater design flexibility when you work with Link-Belt Timing Chains and Sprockets. It's the highest load carrying chain on the market. Chains now being used by some leading car manufacturers measure only $^{11}/_{16}$ inches in width. Narrower designs can mean a vital saving of space.

Equally important — the continuing research and unsurpassed facilities of the vast, new Link-Belt plant combine to make Link-Belt your best bet for a dependable chain source. Our engineers will supply a test drive to your specifications. There's no obligation, of course. Details are in engineering catalog No. 2065.

12.331

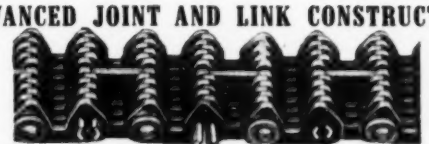


Link-Belt Duplex Timing Chain combines timing and accessory drive functions on this popular engine. Either face of the chain meshes with wheels.



Why SEGMENTAL BUSHINGS mean better performance for your engine

ADVANCED JOINT AND LINK CONSTRUCTION



Removable case-hardened segmental liners or bushings extend across entire chain width —double bearing surface . . . halve bearing pressure on joint

Broached holes in links form lock grip for bushings

Smooth, case-hardened pin, free to rotate between segmental bushings, presents every part of surface for wear

Bushing takes wear at joint—elongation of link hole or eye is negligible

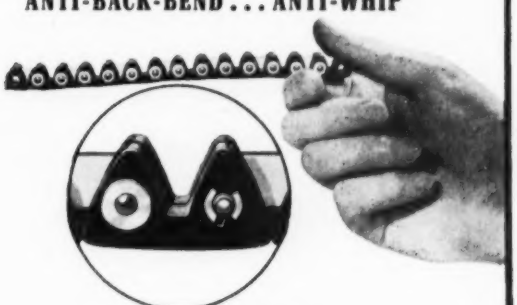
AUTOMATIC JOINT SNUGNESS

After initial assembly in chain, bushings are straight

Segmental bushings are made with slight bow

Bow in bushing acts to keep a snug joint, maintaining chain pitch

ANTI-BACK-BEND . . . ANTI-WHIP



Built-in check in joint limits bushing rotation, checks backbend and whip

LINK-BELT

TIMING CHAINS AND SPROCKETS

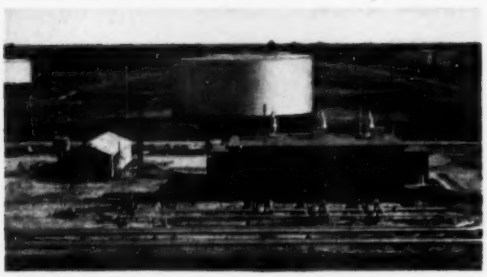
LINK-BELT COMPANY: 220 South Belmont, Indianapolis 6, Ind
Offices in principal cities

Here's real pumping power for Pipe Lines

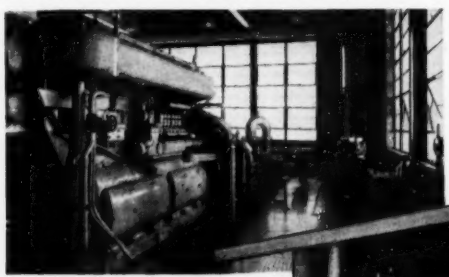
ALCO Diesel engine pumping installation at Patoka Station of The Texas-Empire Pipe Line Company System uses NO spare units.

Operation of these Alco diesels is so reliable that the Patoka Illinois Station uses no spare units—and yet must be ready at all times to pump vital crude oil by pipe line to refineries and connecting carriers. That's why Alco medium speed Diesels have been picked for the job. These dependable engines have operated 96% of the elapsed time at 94% of the manufacturer's rating, using centrifuged line crude for fuel. Operation is so reliable that the station uses no spare units. Such dependable performance is the chief reason why in the last ten years *more Alco Diesels have been installed in oil pipe line pumping service in the U. S. and Canada than any others.* For more details check now with American Locomotive Company, 30 Church Street, New York 7, or the nearest Alco Sales Office at Beaumont, Chicago, Cleveland, Houston, Kansas City, San Francisco, Schenectady, St. Louis.

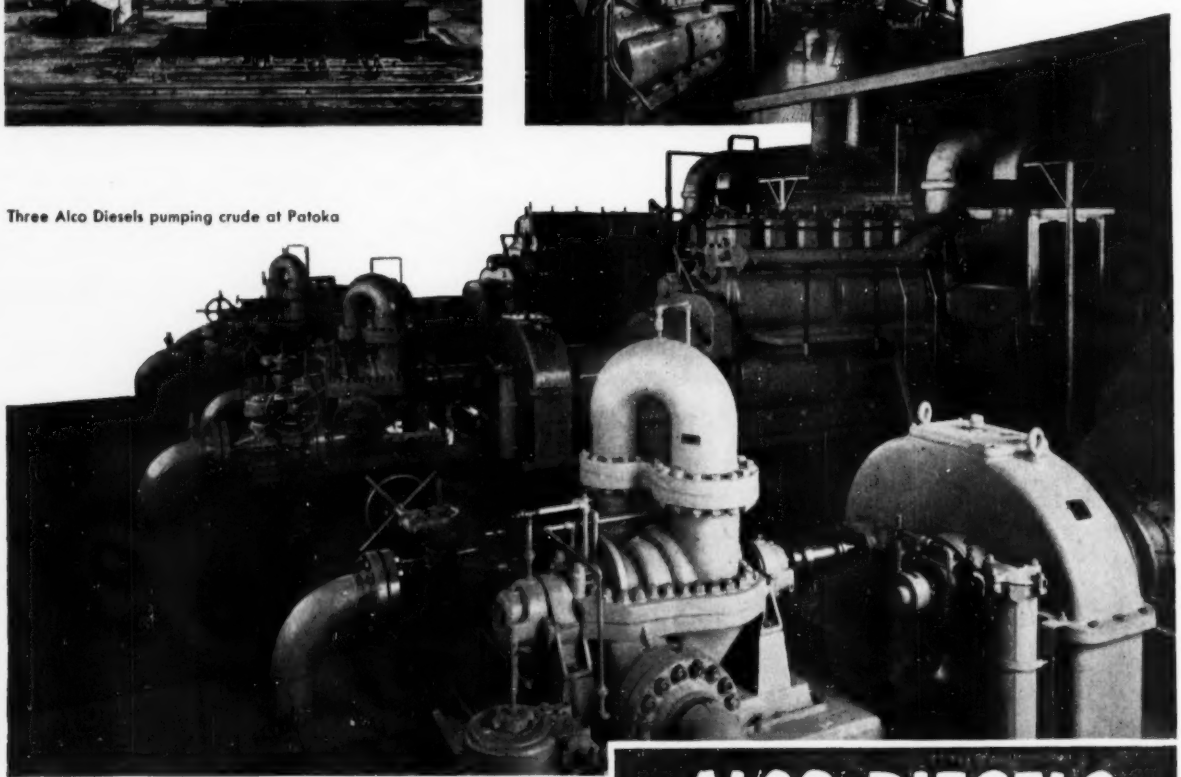
Outside view Patoka Pumping Station



Close-up view of one of the Alco Diesels at Patoka



Three Alco Diesels pumping crude at Patoka



SPEED Vs. WEAR

Remember, since piston speed and journal travel per minute are both almost the same in medium speed and slow speed engines, wear is equivalent as well. Not only do you get unequalled dependability with Alco Diesels—you get long wear and low maintenance costs, no matter how difficult the service conditions.

ALCO DIESELS

THE MARK OF MODERN ENGINEERING

AMERICAN LOCOMOTIVE COMPANY

TOCCO* and the Diesel Industry Progress *Together*

• In the manufacture of many Diesel engine and accessory parts TOCCO Induction Heating has proved a sound method of increasing product quality, speeding production and lowering unit costs. TOCCO-hardening of vi'al parts prevents wear, insures 5 to 10 times longer life—with con-equent customer satisfaction.

A Partial List of Manufacturers of Diesel Engines and Accessories Who Use TOCCO-Hardened Parts

American Locomotive Company
The Auto Car Co.
The Buda Company
Caterpillar Tractor Co.
Cleveland Diesel Engine Div.
General Motors Corp.
Continental Motors Corp.
The Cooper-Bessemer Corp.
Cummins Engine Co., Inc.
Detroit Diesel Engine Div.
Electro-Motive Division
Hercules Motors Corp.
International Harvester Co.
Lima Hamilton Corp.
The National Supply Co.
Waukesha Motor Co.
Eaton Manufacturing Company
Link-Belt Company
Worthington Pump and Machinery Corp.

And These Are Some of the TOCCO-Hardened Parts They Use

Crankshafts
Camshafts
Axle Shafts
Piston Pins
Shifter Rods
Adjusting Screws
Cylinder Liners
Rocker Arms
Cam Followers
Valves
Rocker Arm Shafts
Timing Gears
Shifter Forks
Transmission Gears
Final Drive Gears
Spiders
Universal Joint Assemblies

TOCCO Engineers can probably find applications in your plant, too, where TOCCO Induction Heating can improve product quality, increase production and lower costs. Such a survey costs you nothing and may save you a great deal.

THE OHIO CRANKSHAFT COMPANY

Mail Coupon Today

NEW **FREE** BULLETIN

THE OHIO CRANKSHAFT CO.
Dept. L-4, Cleveland 1, Ohio

Please send copy of "A TOCCO Plant Survey—Your Profit Possibility for 1951".

Name _____
Position _____
Company _____
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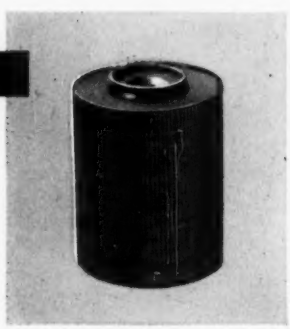
City _____ Zone ____ State ____

AC OIL FILTERS

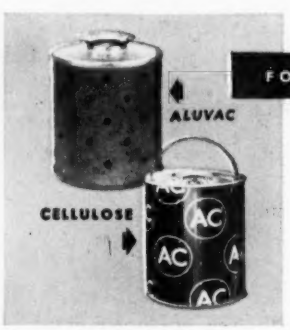
Protection PLUS *for Diesels*

FOR FUEL FILTERS



As protection for fuel injectors and transfer pumps, AC Elements are unequaled. They are engineered for factory-equipment Diesel fuel filters—and are precision-built to AC's highest quality standards. These AC Elements have been proved by millions of hours of service. Your engines need this *plus* protection to assure reliable operations.

FOR LUBE OIL FILTERS



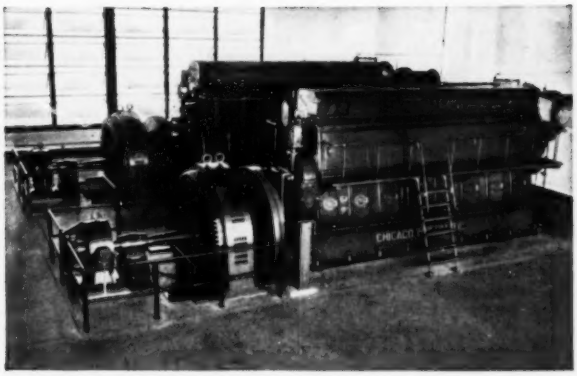
AC Lubricating Oil Filters and Elements are standard equipment on GMC Truck and Coach, Flexible Bus and Detroit Diesel engines.

Replacement elements are available for nearly every make of lubricating oil filter—some made of cellulose and some of AC's new *Aluvac* filtering material. Either type gives your engines protection *plus*.

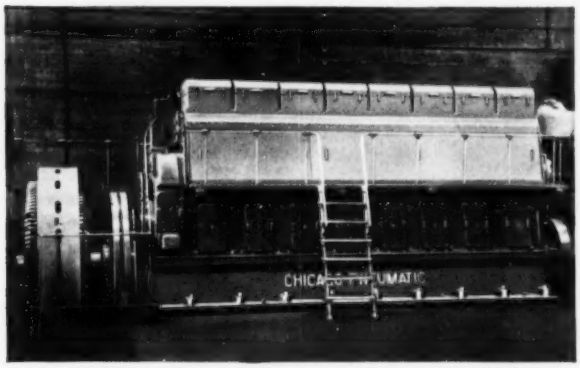
AC SPARK PLUG DIVISION • GENERAL MOTORS CORPORATION

"ONLY *CLEAN* OIL IS *SAFE* OIL!"

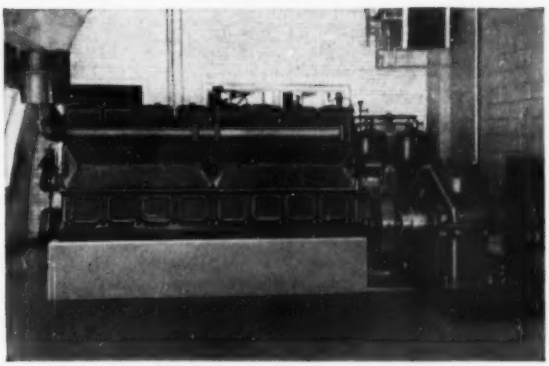
CP medium and slow speed Diesel Engines



Two CP 1500 H.P. Diesels in a western public utility station.



CP 1650 H.P. 8-cylinder Diesel in well known industrial plant.



CP 400 H.P. Diesel in petroleum pipeline station.

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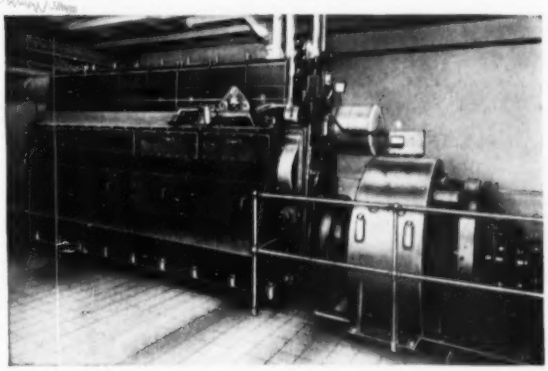

CP 640 H.P. Diesel in large laundry.

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LITTLE THINGS HAVE A WAY OF ADDING UP!

Extra production for defense calls for extra vigilance against machinery breakdowns. Often, these breakdowns are caused by little things—a scored bearing, a clogged oil line, perhaps a worn gear—but these *little* things really add up! For example . . .

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Editorial:

A Time for Planning

How's your power situation? If you have the answer to this on the tip of your tongue, including a plan to cover your projected needs, fine. If you don't have it or are just beginning to evaluate your needs, it's later than you think. Monday morning quarterbacking is a cinch, true, and we realize that the confused state of things in the last few years has created tremendous uncertainty. Many factors, some extraneous, have frequently resulted in delay in placing firm orders even after the need for new engines, improvements or parts has been established.

We know of one case where the alert engineer of a municipal power plant has been vociferously asking—yes, demanding—a new engine for the last two years. Some of the engines that he inherited are nearly 20 years old and have led a hard life. In spite of this, he showed a profit in the neighborhood of $180,000 last year with power rates lower than those in surrounding areas.

The politicians went on record with the people as favoring a new engine to give a reasonable firm plant capacity. A consulting engineering firm was called in for a survey and after a very cursory examination said that the engine was not necessary. The engineer protested, pointing out several factors that had not been taken into consideration, with the result that a second survey was made. Following this, the recommendation called for not one, but two new engines and some new switch gear. The tragic part is that no equipment has been ordered to da'e.

In other cases, power units installed on an emergency basis or for handling peak loads are being pressed into service to meet growing load demands. It's pretty easy to let the situation slide until the unit can't be taken off the line. Then when something happens, there's no emergency capacity.

Delivery time is stretching and there is no telling when the much needed engine or other equipment will arrive, but until the order is placed nothing can be done. The matter goes far beyond the need of the individual or firm, although it is of prime importance to them.

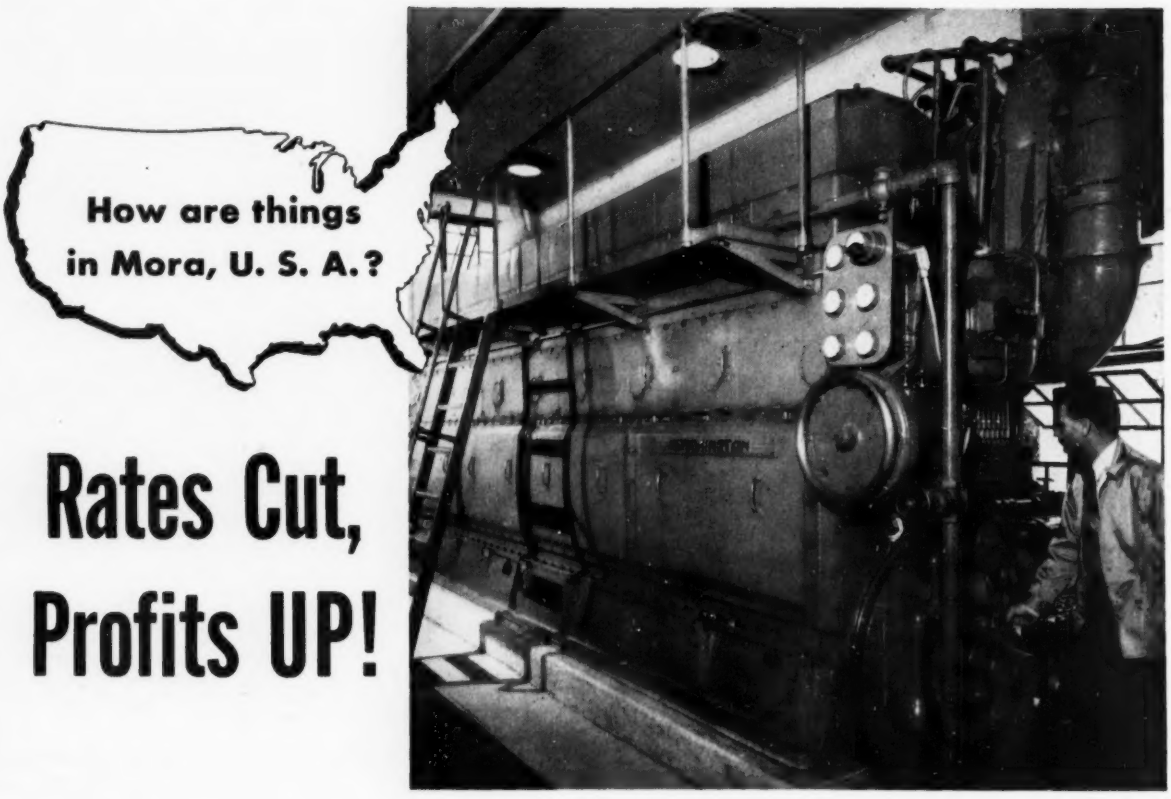
These orders funneling through the engine builders serve as a sound evaluation of the overall engine requirements for purposes of planning. Production and distribution of internal combustion engines with rotative speeds below 750 rpm. are now controlled under NPA's M-44 (see Washington Slants). Builders of the smaller engines will be busy filling rated orders. In short, controls are here.

The tendency in the past for the purchaser to delay his order until the last possible minute and then to jam it through the engine builder's plant on a rush basis won't work any more. Both production and delivery are scheduled and a major controlling factor is materials.

It is the job of the NPA to see that available stocks are distributed in the best interests of the country with defense production coming first. To do an intelligent allocation job it must know the requirements of each industry and this can only be determined from the industry, itself. In turn, our industry can only evaluate requirements on the basis of what they have produced and the orders on hand.

Whether full material requirements for civilian production will be forthcoming depends on the total allocations to the industry less the amount of the total necessary to fill rated orders from defense agencies. The latter also have a responsibility to determine their needs with reasonable accuracy as soon as possible.

Planning is essential at each step of this complex situation. One thing is for sure, you had better get your orders in and your requirements known and included in the planning or you won't stand a chance. A word of warning: Play fair; don't order on vague speculation. You might be depriving someone else with a greater need than yours. In addition to planning, it is a time for ethics; we have a big job ahead.



Rates Cut, Profits UP!

Things are as good in Mora, Minnesota as the song says they are in Glocca Mora. Worthington Diesel engines operated by the municipal power plant in this progressive community have helped produce the lowest electric rate of any full Diesel municipal power plant in the state.

A Worthington 4-cycle supercharged engine, operating at low load factor of 42.6%, produced in 1950 5% more power per gallon of fuel than a 2-cycle engine operating at 59.4% load factor. Following the installation of the Worthington engine, rates were cut in 1949, yet net profits, in 1950, were greater than ever.

Worthington four-cycle supercharged engine is particularly well suited to the needs of a growing community like Mora —whose peak kw load has increased an average of 11% a year in recent years. Even when over-powered, a plant can operate at very low fuel cost and have the added engine capacity when needed without additional investment.

When you buy a Worthington 4-cycle supercharged engine, you benefit, too, from the *longest experience* of any manufacturer with this type of engine. For any engine application, call on Worthington—an engine for any fuel: oil (crude or regular), gas or "dual fuel". Worthington's complete line of engines assures you of the most economical operation no matter what fuel you use.

If gas or any combination of gas and oil offer fuel economies, consider Worthington gas or dual fuel engines. Only Worthington offers such exclusives as dual plunger pumps, gas micro-metering valves for each cylinder and thermal air controls —all built to give optimum performance for the fuel used.

For further details of the dependable, economical Diesel performance that proves *there's more worth in Worthington*, contact Worthington Pump and Machinery Corporation, Engine Division, Buffalo, New York.

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+ HIGHLIGHTS +

● GM produced 44,172 trucks in its domestic plants during February.

● The Rock Island has announced that it will buy more than $7,000,000 of new diesel equipment.

● Record sales and earnings for 1950 have been reported by the Electric Auto-Lite Company.

● The New York Central recently announced placement of an order for 387 diesel units costing $64,000,000. The order is the largest in the road's history.

● The Budd Company, builders of the Budd Diesel Rail Car, has received defense contracts aggregating more than $110,000,000.

● The Erie, now in its 100th year, has 75.4 per cent of its passnger trains and 61.8 of its freight service dieselized.

● If present delivery schedules are met, the Atlantic Coast Lines will have 540 diesel units in service at the end of the year.

● Orders for 38 diesel locomotives, having a total value of approximately $5,000,000 have been received by Baldwin-Lima.

● The Quaker Rubber Corporation has developed, and offered to industry, a "Conservation Maintenance Plan" to help users prolong the life of industrial rubber products.

● Texas Eastern Transmission Corp. recently began construction of its new 791-mile pipeline. The program will involve the construction of 13 compressor stations.

● A new $25,000,000 contract for partial manufacture and full assembly of Army tactical five-ton dump trucks has been awarded to Mack Manufacturing Corp. by the Ordnance-Tank Automotive center at Detroit.

● In its annual report, Fairbanks, Morse reported a 10 per cent increase in sales over 1949.

● Primary aluminum production in January 1951 exceeded that of January 1950 by 31 per cent.

● Eight new GE diesel-electric locomotives will soon be at work in the Belgian Congo hauling uranium and other materials between Leopoldville and Matadie.

● In the past year, General Electric paid $375,000 to its employees for 22,275 suggestions.

● A gas turbine-powered boat is being tested by the Naval Engineering Experiment Station.

● Ruston and Hornsby, Ltd., English manufacturer, has introduced a 75-hp. diesel mine locomotive.

● Production of diesel locomotives in Australia will soon begin under an arrangement between Clyde Industries of Sydney and EMD.

● The Ninth Edition of Petroleum Facts and Figures came off the press on April 15. The API compiled the data included in the publication.

● Class I railroads had 1627 diesel locomotives on order on March 1. The total number of orders for all types was 1652.

● The B & O has recently installed modern equipment for servicing and maintaining diesel locomotives assigned to the Smithfield, Pa. territory.

● The nation's known proved reserves of crude oil, natural gas liquids and natural gas were boosted to new all-time peaks in 1950.

● The Santa Fe, in its annual report, lists substantially lower maintenance costs as one of the major factors contributing to the net income of $82,-141,791.

● The Illinois Central has ordered 44 diesel locomotive units from EMD.

● Military contracts now absorb eight per cent of the output of Federal-Mogul Corp.

● More than 35 per cent of the unfilled orders on Westinghouse books are for military requirements.

● Allis-Chalmers, in its annual report, showed a profit increase of almost 12.5 per cent over 1949.

● Less than twelve months after 300 acres of unimproved land near Joliet, Ill., was acquired, Caterpillar Tractor Co. has produced its first scraper in a new plant under construction.

● Cummins Engine Co. regional managers held a three-day meeting at Columbus, Ind., March 17 to 19.

● Canadian National Railways now has 180 diesel locomotives in operation.

● Detroit Diesel will exhibit models of its Series 71 and 6-110 engines at the 1951 Coal Convention and Exposition, Cleveland, May 14-17.

● The MKT will soon be completely dieselized when 11 diesel locomotives recently ordered from EMD are delivered.

● More than 43 per cent of freight traffic and 60 per cent of switching service on American railroads is now performed by diesels.

● A simple 2-cycle, lightweight, air-cooled diesel, capable of operating on fuels ranging from diesel fuel to 100-octane aviation gasoline has been developed by the Air Force.

● Crude oil reserves of the General Petroleum Corp., a Socony-Vacuum affiliate, have been increased considerably by the completion of a second well in the Slick Creek, Wyoming, Field.

The World's Largest Pipeline System—

"Tapline" Depends on Diesels

Saudi Arabian oil is moved 3500 tanker miles closer to the markets of Western Europe as well as to the United States with the completion of the world's largest oil pipeline system by the Trans-Arabian Pipe Line Company, an American concern.

Oil for the restoration of Europe's productivity and for the conservation of Western Hemisphere reserves flows through 1068 miles of pipe to discharge 300,000 bbl. per day (initial capacity) on the shores of the Mediterranean. Source of the bulk of power for both electricity and pumping is diesels—some 60,840 horsepower.

Take a look at a map of the Middle East. The oil country of Saudi Arabia is near the coast on the western shores of the Persian Gulf. Transportation of crude oil by tanker the length of the Persian Gulf, the Gulf of Oman, through the Arabian Sea, the Gulf of Aden, the Red Sea and finally the Suez Canal in order to reach the Mediterranean is quite a trip—a 3500 mile one. Oil men were quick to see the tremendous savings in time and money that were possible if it were feasible to pipe the oil across the sands, and gravelly plains of the Arabian Peninsula.

This engineering challenge became a reality when in December, 1950, the Trans-Arabian Pipe Line Company announced the completion of such a pipeline and the loading of the first tankers at the Mediterranean terminus at Sidon in the Republic of Lebanon.

The significance of this imaginative project is international in scope. The American oil industry was able to meet all domestic requirements and still supply most of the needs of Western Europe and other parts of the world until about 1947. In that year consumption exceeded production and it was apparent that the deficit would have to be imported. The Latin American reserves are adequate for many years to come as a supplement to domestic production, but the advisability of tapping other sources in the interest of conservation is evident in view of the world situation.

Oil in commercial quantities was discovered in Saudi Arabia by the Arabian American Oil Company in 1938 and facilities developed in time to provide huge quantities for our Armed Forces. At that time American taxpayers benefitted greatly, since the Navy was able to draw heavily on the supply under special pricing arrangements. Now, benefits are extended to the international scene.

American and European markets are moved 3500 tanker miles closer to the source of crude. To appreciate what this means, figure that it saves a 20-day, 7000-mile round trip for a tanker plus the Suez Canal toll of $0.18 per bbl. Figuring on the basis of a T-2 tanker this amounts to about

$20,000 per trip, to say nothing of approximately 6500 bbl. of fuel burned and the other expenses of ship operation. The time element alone is an important factor and could become even more so. For example, it is said that it was possible to move up D-Day for the Normandy landings a year because of the Little and the Big Inch pipelines.

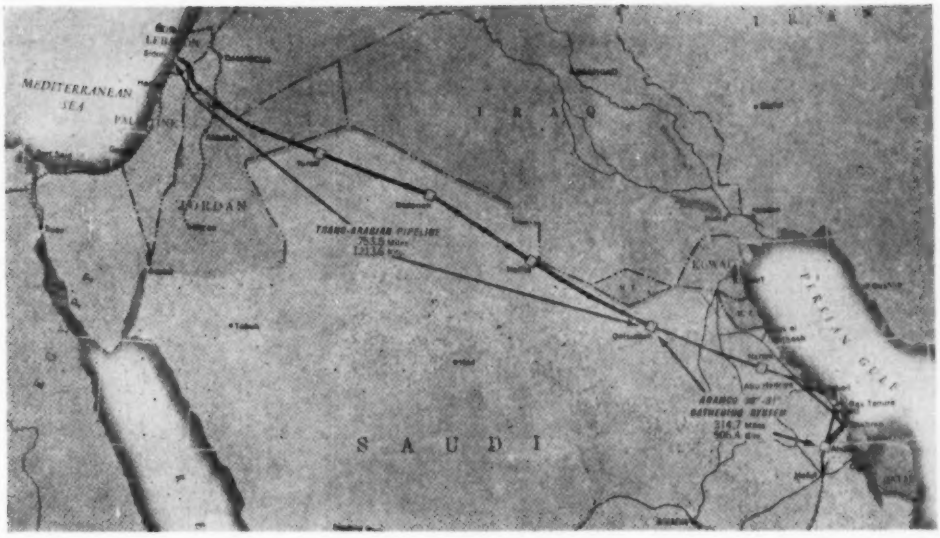
The Arabian American Oil Company or Armco was originally owned by the Standard Oil Company of California and the Texas Company. In 1948, Standard Oil Company (New Jersey) and Socony-Vacuum Oil Company were added to the Aramco partnership with corresponding shares in the Trans-Arabian Pipe Line or "Tapline" as the project has been named by the Arabs.

Geographic Details

Crude from the oil wells is collected and starts its journey to Sidon from the Abaqaiq pump station. In the course of its 1068 mile trip it crosses several types of terrain—all bad. It starts with heavy sand dune country, changes to level or sloping gravelly plains and then climbs to a rocky area to reach its maximum elevation of 2975 ft. above sea level. No water is encountered until the route descends a steep escarpment to find running streams before reaching its terminus.

Summer temperatures run as high as 122° F and above, while winter temperatures below 40° are rare. The interior region is subjected to periodic and prolonged wind and dust storms called "shamaals". Rainfall may average only 3 in. per year and the humidity runs less than 7 per cent. Obviously, water is scarce and a continuing problem. These are all factors affecting the design of machinery installations, as will be seen later.

They also affect the personnel re-



Route of the Trans-Arabian pipeline and the Aramco 30"-31" gathering system. Starting from Abqaiq at the lower right crude oil is pumped by five additional stations until it reaches the terminus at Sidon, Lebanon, on the Mediterranean (upper left). The three men shown at right typify non-Americans employed in the pipeline operations. The Saudi Arabian at the top cheerfully mixes eastern headgear with a western shirt. Below is a contractor's employe engaged in brick manufacture. At the bottom is a Saudi Arab pipeline supervisory worker.

quired to operate the pumping stations and require elaborate provisions for their comfort. The stations are necessarily isolated but large local populations are springing up. Trees are a rarity in the arid, barren land.

General Details

The complete pipeline is divided into two portions, the Aramco gathering system, comprising 314.7 miles of pipe, collects and starts the oil on its way, joining the balance of the line at Station No. 3. Diameter of the pipe is 30 and 31 in., the two sizes being selected to permit nesting of the pipe for more economical shipment. Some of the line is buried, some is on the surface and ramped where the route crossed traditional camel trails.

Six pumping stations are spaced along the route of the pipeline. These are given Arabic names and run in sequence from east to west as follows: Abqaiq; Nariyah; Qaisumah; Rafha; Badanah; and Turaif. Each station is approximately 180 miles from its nearest neighbor station and is a community within itself. About 250 individuals are employed at each of the stations at the present time, but eventually 125 persons will be sufficient to maintain normal operation—85 per cent of whom will be non-Americans.

Power Equipment

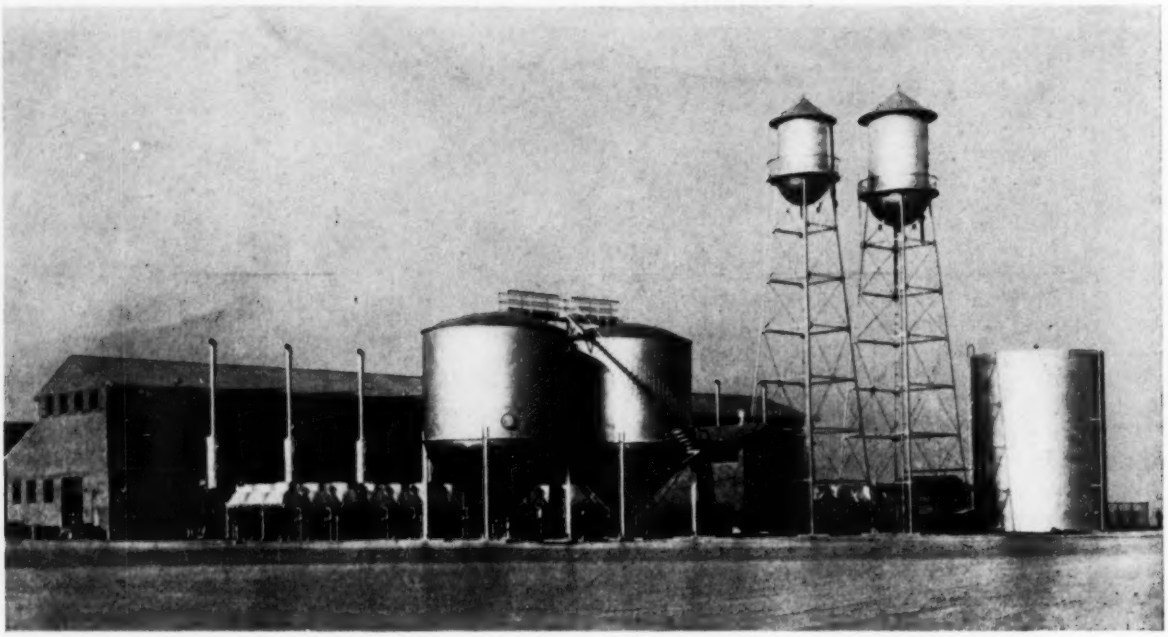
A total of 39 diesel engines were involved in providing the necessary power for the stations. The engineering committee of the Trans-Arabian Pipeline Company issued the detailed specifications on which ten engine companies submitted bids. Worthington Pump and Machinery Corporation was awarded the contract.

The engines selected were the Models SEH-6 and SEH-8. All are vertical, turbocharged, 4-cycle units with a 16 in. bore and a 20-in. stroke. They have, respectively, six and eight cylinders. The larger units are normally rated 1760 hp. at 360 rpm. and about 120 bmep. with the smaller, 1320 hp. at the same speed and cylinder pressure. The higher horsepowers are used for pumping and as the desired input speed to the gears is 350 rpm., power is reduced to 1710 bhp. Also, and in accordance with standard practice for all engines, further derating of all the engines is necessary due to high ambient temperatures (discussed later) and the altitude of the installation. Net horsepowers therefore vary from station to station.

Before Worthington commenced the building of all the engines at the Buffalo (New York) Works they ran comprehensive factory tests simulating expected operating conditions to the greatest practicable degree. When satisfied, they assembled and installed a pilot engine at Abqaiq, although steam turbines were to become the form of power used at this location. The need for steam to stabilize the crude oil was a major factor in its choice as the eventual source of power. At the time of the test, however, Abqaiq was headquarters for the crew and there was an immediate need for power. Thus the test engine was put to use on the first available load in the area. Much additional information concerning operation in that area was obtained and was later put to good use when the other stations were placed in commission.

With the exceptions of the steam-driven Abqaiq station and of Turaif where there are four engines, a total of five engines are installed in the other four stations for driving Byron Jackson centrifugal pumps through Falk gear speed-increaser units. Four pumps are used in series with approximately a 205-psi. differential per stage which combined with a 45-psi. discharge pressure from the booster pumps, totals about 865-psi. discharge pressure. The fifth unit is a spare.

Three generating units, each consisting of an engine direct-connected



The Qaisumah station. Engines and driven equipment are housed inside. Maxim exhaust silencers are seen with the Alco aircoolers next. The two tanks with conical bottoms are for settling, etc., of the crude oil used as fuel. Others are water tanks. Flat, gravelly and arid nature of the area is apparent.

to a 800-kw. General Electric generator, are installed at each of the five stations. Two units are in regular service giving an output of 1600 kw. with the third serving as a spare. The power is used for the heavy and minor industrial equipment such as auxiliary booster pumps, machine tools, blowers, welders, etc., and the residential load. The latter is unusually heavy since it was Aramco's plan to make life as comfortable and attractive as possible for the employees.

In view of the climate, it is understandable that a heavy air conditioning load would exist. Even drinking water is chilled and distributed in insulated mains. Two York freon reciprocating compressor type units, total capacity 180 tons, are used for this purpose. In addition, several Trane air conditioning units are used.

Scavenging System

From performance noted on the pilot engine at Abqaiq and the later engines now operating on the line, it was found that the engines were not susceptible to dust and sand when they were "buttoned up". The air intake filters on the Elliott-Buchi turbochargers were effective in protecting the scavenging system and cylinders while the balance of the engine including the valve gear covers were tight.

When one was working on the engine with doors and covers off it was necessary to take some precautions. In the inadequate building housing the pilot engine it was necessary to close up the engine when the shamaals (sandstorms) started. To offset this condition, the permanent buildings were equipped with large fans that drew air through water baths to create a slightly positive pressure within the structure. This served the twofold purpose of preventing the filtering of sand into the building through openings around doors, windows, etc., and providing cooler, clean air. The scavenging air for the engines was taken from inside the building. This system also reduced the precautions necessary when working on the engine.

As mentioned, the ratings given earlier are subject to correction due to the extremely high ambient temperatures encountered in this area. It is understood that these ratings apply for ambient or inlet air temperatures of up to 90° F. Above this point, corrections are made inversely as the absolute temperature, and were made to 120° F, although higher temperatures are encountered. The correction amounted to roughly 3 hp. per degree rise above 90° F, giving a rating of 1620 hp. at 350 rpm. for the 8-cyl. engines and 1230 hp. at 360 rpm. in the case of the 6-cyl. engines.

Fuel System

Obviously, the most convenient fuel for the engines was the crude in the line. Its use would lessen first cost and secondary cost as well as inconvenience involved in transporting some other fuel. Crude is not necessarily a bad engine fuel; in fact, it is generally better than most residual fuels since it contains the high ends later removed in the refining process.

It is interesting to make a rough analysis of the comparative fuel consumption of the pipeline engines versus equivalent tanker transportation. Average consumption for the 29 operating engines is roughly, 50,000 gal. daily. This delivers 300,000 bbl. daily at Sidon. Three T-2 tankers would be required to deliver about 330,000 bbl. Round trips would have to be figured and, incidentally, it would require an excess of 60 tankers to maintain the rate of delivery continously. T-2 tankers burn (conservatively) 325 bbl. per day or 13,650 gal. The round trip takes 20 days so 273.-

000 gal. would be consumed and for the three tankers, 819,000 gal. The economy per bbl. delivered is apparent even without considering canal tolls.

Getting back to the fuel system, two large fuel storage tanks, round with conical bottoms, are provided at each station. Each holds 1500 bbl. of oil and they are used one at a time.

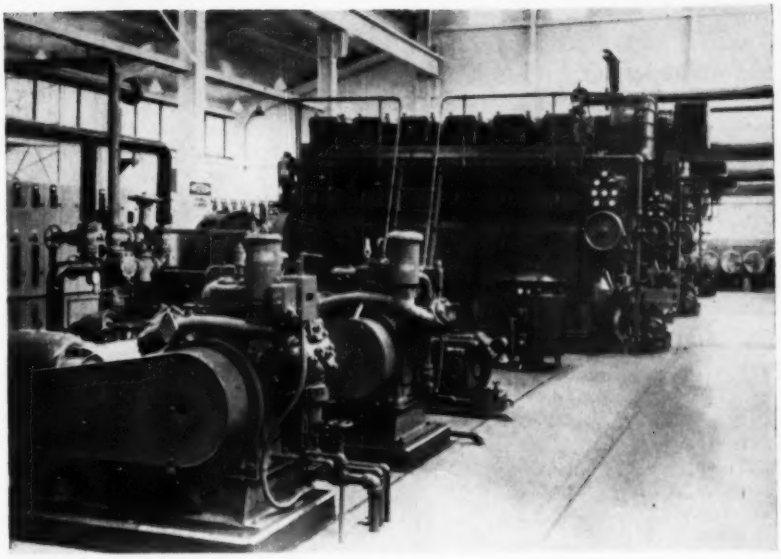
A definite method of cycling is followed . A tank is filled with crude from the line. It is then left to settle for about four or five days at which time about one-third of the tank's bottom is drained down through the lower end of the funnel-shaped section and back into the line. In this manner all of the sediment and water sumping into the conical section is removed and the remaining oil is used for fuel.

The take-off for the engines is at the top of the conical section, so that there will be no danger of any left-over water or sediment getting to the engine and causing trouble. The settled and drained tank is then switched to service and the same cycle started in the other tank.

In spite of high temperatures during most of the year, the winter months in Arabia get comparatively cold particularly in the elevated plains country across which "Tapline" runs. For this reason, it was found necessary to recommend heating equipment for the fuel oil. A small heat exchanger was installed in the fuel lines to the engine. A recirculating feature of the fuel booster pump on the engine was used to circulate fuel back to the line leading from the outside tanks and thence back to the engine again. This served to keep the fuel lines warm and eliminate the danger of waxiness of the oil retarding the flow to the engine.

It was not necessary in view of the viscosity of the crude to get into high pre-heating. Temperature limitations on the fuel in an unpressurized system run from about 90° to 150° F. Above the high limit there is danger of gas forming which would bind the booster and the injection pumps.

Before the fuel manifold and after the booster pump on the engine is a duplex Cuno *Micro-Clean* filter. The felt elements filter the oil, removing particles of micronic size in order to protect the injection equipment.



Interior of plant showing the arrangement of the units for generating electrical power. Generators and a portion of the switchboard can be seen over the air compressors in the foreground. Note the lube oil filter near the engine and orderly arrangement of drums in the background.

Lubricating Oil System

Very little difficulty has been experienced to date in burning the crude oil and the matter of wear is still to be determined after longer operation. Sulfur content of the crude being used varies between 1 and 2 per cent and the engines appear to take it in their stride. Compounded lubricating oils are being used due to their ability to promote engine cleanliness.

The filtering system is conventional and consists of U. S. Hoffman filters arranged for by-pass operation. Those for the larger engines have six cartridges and the smaller have three. Cotton waste is the filtering media used with the additive type lubricating oils. Both size filters are equipped with electric heaters, 9 and 6 kw., respectively, to insure optimum viscosity for filtration.

Cooling System

Climate including wind direction and velocity, altitude and the limited water supply were factors in determining the type of cooling system selected. Reliability was of utmost importance. Flexibility of operation to permit close control of engine temperatures throughout the ambient temperature range as well as ease of construction and maintenance were also criteria.

The units selected were the Alco Aircoolers. These are essentially a water-to-air heat exchanger. This permits the use of a closed cooling system and practically eliminates water losses that are common to towers, spray ponds and other type evaporative coolers. The units are of the induced draft type with fans and motors located under hoods where they are protected from infiltration of dust and sand into the bearings, etc. Direct motor connection to the fans reduces the possibility of trouble from this source by eliminating gearing and shaft bearings.

The cooling elements are of *Uni-Bundle* construction and consist of seamless Admiralty tubes with copper fins that are both mechanically and solder bonded to the tube for maximum heat transfer efficiency. These tubes fit into headers that are weldments. Brass plugs in the rear face of the weldments opposite each tube provide for easy accessibility.

Angle iron structures support the tube bundles horizontally well above the ground level where there is little chance of erosion from blowing sand. The path of the induced draft is vertical so wind direction or velocity have minimum effect. Also, the air leaves the cooler traveling upward at maximum velocity, so that recircula-

View of another station from a different angle serves to illustrate the uniformity in the station design. The features seen in the view of Qaisumah are easily identifiable. Workers in foreground stand by pipeline valves.

tion of the heated air is improbable.

Ambient temperature range for the design of these units was 40° F to 122° F. It is required that the coolers at each station cool the pumping engine jacket water at a rate of 2325 gpm. from 170° F to 155° F at the maximum design ambient temperature. Cooling water rate for the generator engines is 1080 gpm. with the same conditions. The lube oil cooling water rate is 975 gpm. for the pumping engines and 390 gpm. for the generator units. The water must be cooled from 145° F to 135° F when the design ambient temperature is at a maximum. Figures are on the basis of maximum conditions with five pumping engines and three generators in operation.

There are 10 jacket water and 5 lube oil water coolers for the pumping engines and three of each for the generator units. There are some differences between these groups of units to suit them for their heat load. Variations are made in fan diameter, tube length and number of passes. However, for the sake of standardization, the number of types and sizes of parts were cut to a minimum.

The selection of a group of small fans in place of a few large ones provides a means of close temperature control. In the case of the pumping engine jacket water coolers, 10 units with 3 fans each provide 30 steps of temperature control. All five stations, due to altitude, etc., have different cooling requirements and for further control, each fan has three pitch settings for optimum adjustment. Once adjusted, the exact number of fans needed to get the desired temperature can be manually or automatically controlled. For example, when the ambient temperature drops 6° F from the maximum design temperature, one third of the fans can be shut down.

"Yuh keep it clean enough to eat off, huh?"

Conclusion

These are some of the major features of the power installation. Actually, they are a small but vital part of the tremendous engineering project. Earlier, mention was made of its significance to Europe and this country. Another phase is its impact on Saudi Arabia.

A newly created "middle class", introduced by Aramco, is rippling out in an ever-widening circle. The Arabs are proving to be surprisingly adaptable. They have the ability to learn and have quick perception of mechanical trades. They have already become first class mechanics and are proving leadership ability.

Improved transportation and living conditions, increased income and the introduction of new trades will all leave their mark on the country—for the better. The arrangement between Aramco and the Saudi Arabian regime whereby, in effect, profits are split in half will pour new wealth into the country for the betterment of all.

Washington Slant

LAST MONTH, we closed on the note of materials for maintenance, repair and operating supplies. It is heartening to note re-occurring concern on this subject. Automotive Replacement Parts Manufacturers Industry Advisory Committee went so far as to ask NPA to consider exemption of the industry from materials conservation orders. NPA informed them of expected provisions to keep industrial and public transport running. Also, Controlled Materials Plan, being worked out, would have provisions for civilian MRO requirements.

REG. 4 COVERS MRO requirements for agencies or businesses having DO ratings. MRO (maintenance, repair and operating) materials are obtainable on priority by extending DO ratings identified by the symbol "DO-97". Provision is also made for minor capital additions not to exceed $750.00. Regulation outlines methods of determining MRO quotas, limitations, use exceptions, etc. and Direction 1 states provisions in force during transitional periods.

HAND TOOLS CAN BE MRO MATERIALS when purchased by an employer for sale to employees for use in the business or when constituting operating supplies issued to employees without charge. Hand Service Tools Industry Advisory Committee has recommended establishment of standardized types and varieties of hand tools to conserve critical materials.

NPA appointed a task group for study. Further, NPA must assist in getting sufficient material to maintain adequate stocks of these vital implements. Tool and Die Manufacturers Industry Advisory Committee stressed same problem of shortage of material, mostly on critical list, for production of essential tools and dies for defense effort. Manpower in this field is also extremely tight and government is asked to help find a solution.

MACHINE TOOLS ARE NOT MRO materials. Units with costs of over $500.00 for a "ready-to-go" package (spares, separate drives, etc., not included) come under M-40 and M-41. DO's cannot be extended for machine tool purchase (Reg. 2) except by "service purchasers" for "service groups" (subdivisions of Dept. of Defense) or General Services Administration. List of service groups is classified "Restricted" and issued to tool builders making equipment listed in M-41, Exhibit A. Distribution is on basis of up to 70 per cent for service purchasers, special rated purchasers next with any balance to unrated buyers. Distribution among service purchasers is scheduled on percentages of monthly production, outlined in M-41.

GSA WILL PLACE FIRM ORDERS with tool builders in accordance with NPA recommendations, carrying a DO-98 rating. This helps in the race for materials. Such orders have a provision for elimination of items from the order to the extent that equivalent items are invoiced and shipped to other purchasers or by direction of the NPA. Thus, tool builders can extend a rating for materials to construct needed tools in advance of receipt of normal rated orders.

POWER EQUIPMENT PRODUCTION AND DELIVERY is regulated in M-44. Purport is to require manufacturers to file monthly reports, showing orders on hand and related production and delivery schedules. Further, they must maintain, modify or alter these as NPA directs. Order is pertinent here to internal combustion engines, generators and generator sets wherein the prime mover, whether diesel, dual-fuel or gas engine, has speed of 750 rpm. or less. Exception is for order or orders from a single customer for power equipment or parts with an aggregate value of $5000.00 or less. In short, all large engine production and delivery is now regulated.

NPA POWER IS BROAD and permits them to (1) direct the return or cancellation of any order on the builder's books; (2) direct changes in production and delivery schedules and specify sequence of filling orders; (3) reallocate a builder's orders to other facilities; (4) and to take such action as deemed necessary concerning order placement and production or delivery of power equipment or parts thereof.

DEFENSE NEEDS ARE HELD PARAMOUNT when determining NPA action. Decisions to implement this policy are at discretion of NPA without regard to Reg. 2 or preferences or priorities assigned to particular rated orders. Adherence to production and distribution schedules is stressed and spelled out in M-44, Secs 6 and 7. NPA assistance in obtaining necessary materials is pledged in support of the above.

"HARDSHIP CLAUSES" are in all "M" orders providing for request for adjustment or exception. Basis can be particular hardship not general to others in the industry, or that enforcement would not serve interests of national defense or public interest. Under the latter come public health and safety, civilian defense, or dislocation of labor.

NOTE THE EXCEPTION in M-44. It may get you off the hook for some much-needed engine parts.

Diesels in the Oil Industry

by George W. Grupp

A DIESEL engine was first used by the American petroleum industry in 1903 by the Standard Oil Company of New Jersey at its Fawn Grove, Pa. pipe line station. But, internal combustion engines did not endanger the supremacy of steam until about 20 years ago.

Motivated by the desire for greater portability of oil industry equipment and to escape from the water and fuel problems in field operations, internal combustion engines have largely replaced steam engines during the past fifteen years.

Drilling rig in Redwater, Alberta powered by two Caterpiller D13000 diesels. The engines and drive are shown below.

At first, internal combustion engines were handicapped by their lack of sufficient power for deep drilling and for pumps of large capacity, and by their lack of satisfactory control.

Today, however, with dual fuel, supercharging and other engineering improvements, diesel engines are now able to produce enough power to handle any capacity of petroleum products pumps, and to drill to depths of over 20,000 feet.

The oil industry of today is a large user of diesel engines in its many kinds of activities. It is impossible to ascertain the exact number of diesel engines used by drilling contractors, oil companies, pipe line companies, and retail and wholesale oil distributors, because there are no complete statistics available. However, one can gain some idea of the total diesel horsepower used in field and pipe line operations by the quantity of fuel consumed by oil companies for such purposes. But even this is faulty because many of the oil industry's diesel engines are dual fuel engines.

Most of the petroleum industry experts, however, are of the opinion that the most common form of prime mover at main-line pumping stations is diesel power.

It is also their opinion that the trend is away from butane, gas and gasoline engines to diesel engines on heavy rigs because of their lower operating costs, especially in wildcat operations. This is partly due to the drilling contractor's need for multiple diesel engines of moderate horsepower compounded with spline type clutches which permit the operation of one, or two, or all engines for pumping, drilling, and hoisting operations from a control panel.

Many petroleum industry operators have found it is advantageous to use several moderate sized diesel engines for a number of other reasons. For example, compounding makes expansion more easy; it simplifies maintenance procedure; it results in stand-by economy; it makes for less and more uniform engine wear; it enhances operating efficiency; and it provides greater flexibility.

An operator who uses one size and make of diesel engine can fit his horsepower more closely to the fluctuating loads than is possible if he operates a number of engines of different capacities.

When all compounded engines are of the same moderate size they can be operated near their rated capacity to meet any load. This results in a saving of fuel, in improved operating conditions, and in greater over-all efficiency of the engines.

Uniform diesel engines also result in less wear per installed horsepower. If a variety of capacities are used, the larger units have higher wearing costs. Where all units are of the same moderate size the engines can be operated in rotation to keep the wear of each unit about the same.

The operation of uniform sizes and make of engines simplifies maintenance procedure, reduces required spare parts stocks and number of special tools, and allows part interchangeability.

There is greater stand-by capacity economy when all engines are of the same size. When a variety of sizes

Diesel Fuel Consumption by Oil Companies and by All Others In 1948 and 1949

State	—in thousands of barrels— Consumption of diesel fuel by oil companies in their field & pipeline operations (1)	Total Sales of diesel fuel for all purposes by all users
Alabama	4	1,341
Arizona	—	469
Arkansas	2	1,014
California	141	13,075
Colorado	—	824
Connecticut	1	995
Delaware	—	60
District of Columbia	—	342
Florida	6	2,273
Georgia	2	1,379
Idaho	—	495
Illinois	4	4,796
Indiana	5	1,650
Iowa	1	2,140
Kansas	19	1,791
Kentucky	3	1,260
Louisiana	50	3,184
Maine	2	368
Maryland	1	1,303
Massachusetts	2	1,563
Michigan	2	1,980
Minnesota	—	1,306
Mississippi	5	676
Missouri	11	1,899
Montana	1	1,187
Nebraska	—	1,019
Nevada	—	1,166
New Hampshire	—	210
New Jersey	3	3,365
New Mexico	1	533
New York	2	5,535
North Carolina	2	1,390
North Dakota	—	398
Ohio	3	2,659
Oklahoma	28	1,400
Oregon	6	1,751
Pennsylvania	1	3,905
Rhode Island	—	119
South Carolina	3	756
South Dakota	—	389
Tennessee	3	1,272
Texas	78	6,349
Utah	2	884
Vermont	—	73
Virginia	18	2,115
Washington	19	2,726
West Virginia	—	284
Wisconsin	1	1,355
Wyoming	9	896
Total, U. S. in 1949	441	87,919
Total, U. S. in 1948	410	85,505

SOURCE: Senate Committee on Interior & Insular Affairs, 1951.

NOTE: (1) This does not include the fuel consumed by tankers and tugs.

are used the stand-by capacity will usually have to be equal to the largest unit. And by compounding moderate sized units gradual expansion can be made to meet the oil operators needs without an excessive amount of available power.

As might be expected the compounding of diesel engines can be found in pipe line pumping stations as well as in the field. In the Tinsley field of Yazoo County, Mississippi three 450 hp. Superior diesel engines power the rotary drills, now drilling below 8000 feet, in a 12,500 foot deep test. The compressor on this project is powered with a General Motors diesel.

Not so long ago, the Rocky Mountain Drilling Company in 4800 hours of non-stop drilling bored to a depth of 17,600 feet with the aid of four Superior and two General Motors diesel engines.

The compactness of diesel engines for drilling means lower moving costs, speedier set-ups, faster moving from site to site, and the drilling of a greater number of holes in the same over-all time.

The fuel consumption of diesel engines for rotary drills under continuous loads averages about 0.440 lbs. per bhp.-hr. for a 150 bhp. engine at 900 rpm.; about 0.440 lbs. per bhp.-hr. for a 185 bhp. engine at 900 rpm; and about 0.445 lbs. per bhp.-hr. for a 245 bhp. engine at 900 rpm.

Diesels are also used extensively in marine oil drilling and highway petroleum transportation. One of the outstanding floating drilling rigs is the Creole Petroleum Corporation's diesel electric barge stationed on Lake Maracaibo, Venezuela. The generators of this rig have a capacity of 1500 kw. to enable it to drill to a depth of 15,000 feet. One of the special features of this rig is its ability to continue drilling operations throughout most storms because the power is supplied through flexible electrical cables. In fact, the barge can be moved away from the caissons and continue operations because it is also equipped with flexible mud lines.

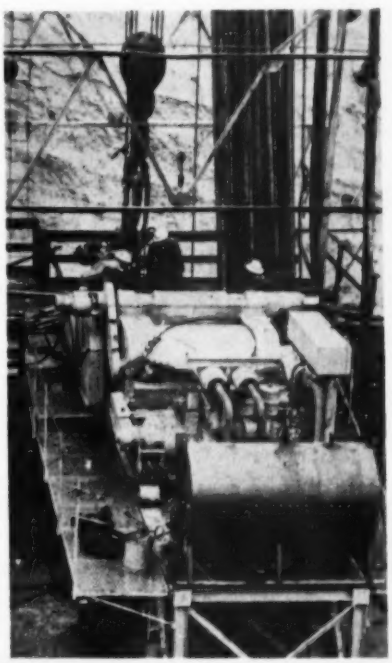
The oil industry uses diesel engines as the motive power for its tankers, tugs, dredges, floating drilling barges, rotary drilling, spudding rigs, compressors, cranes, generator sets, winches, hoists, pumps, earth moving equipment, construction and maintenance equipment, and tank trucks.

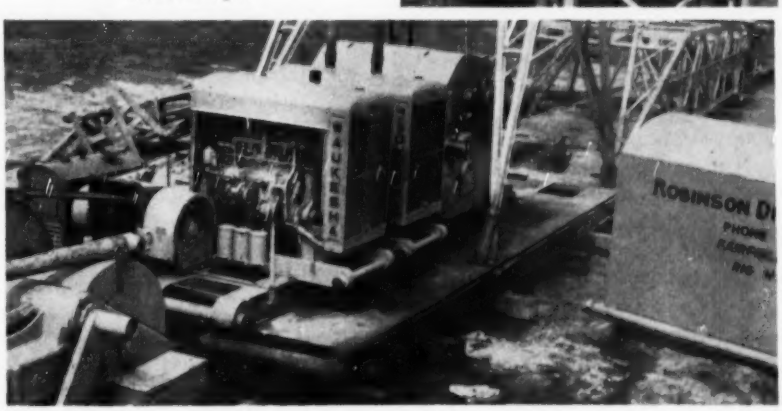
Tank trucks are used primarily for the distribution of refined products to service stations and to the ultimate consumers. Most of these trucks and tractors are gasoline engined. Where diesel engines are used they compare favorably with gasoline engines.

Diesel crawler tractors are generally used in the construction, maintenance and servicing of pipe lines. Side boom diesel tractors are used to dope and wrap pipes, to lower pipes in the trenches, and to spot pipes after they have been unloaded from trucks. They are also used in pipe welding and pipe bending operations.

Diesel ditchers are used to cut pipe line trenches. Diesel bulldozers are employed in backfilling, in clearing

(*Continued on page* 144)





(right) Heavy duty well servicing hoist powered by GM Detroit "Twin Six" diesels. Two Waukesha engines provide power for the drilling rig shown at right.

Diesel Engines or Gas Turbines for Locomotives

At its inception, the diesel engine caught public fancy and like so many new things about which little is known, was subject to many premature and unjustified claims. Whatever the source of such fanciful ideas, it was not the manufacturer. He knew better.

The gas turbine for locomotive application is suffering somewhat the same fate. Here again, it is not the manufacturers that are making the extravagant claims; they are the first to admit that, while they think that they have something of great potential, it is relatively undeveloped.

This article is a comparison of the two prime movers for locomotive application. Recognition is given to their relative degrees of maturity and design refinement. A major purpose of the article is to clarify the situation and reduce things to a true perspective. Builders of both types of locomotives seem to agree that this is no time to hold up purchases of vitally needed locomotives to "wait for something better."

Material for this abstract was taken from the text of a paper presented by Mr. N. C. Dezendorf, director of sales, Electro-Motive Division of General Motors. The author is also a member of the Industrial Advisory Committee of the United States Congress. The paper was prepared for the round table discussion program of the Congress in Mexico City.

IN proving more attractive than the steam locomotive which it superseded, what were the outstanding advantages that the diesel locomotive had in railway applications, and to what extent are these retained by the gas turbine? A comparison is given in the discussion below.

Engineering

Diesel application to locomotives offered engineering advantages of value, not only to railroads but also to manufacturers. These include a compact, light weight prime mover of reasonably low cost; a satisfactory and efficient form of transmission; and a locomotive unit which could be built in standard sizes suitable for a variety of railway applications by varying only the number of units operating together and gear ratios on traction motors.

By comparison the gas turbine is lighter and more compact than the diesel of corresponding power. While there may be some justification for the claim that gas turbines will be cheaper to manufacture than diesels, the current cost advantage favors diesels. The general form of the locomotive unit and the type of electric transportation will apply equally for the gas turbine.

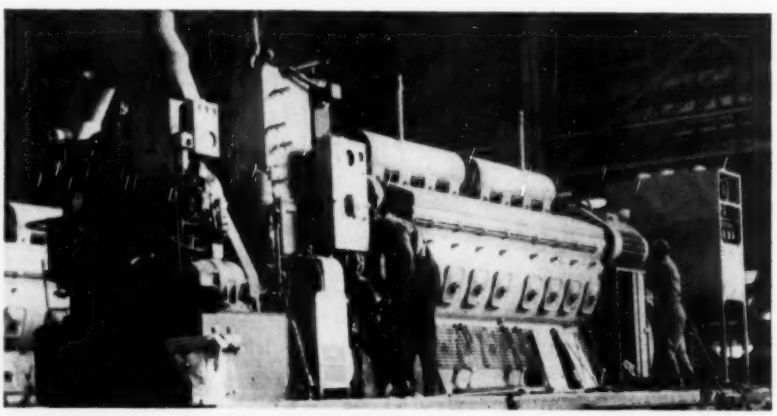
Operation

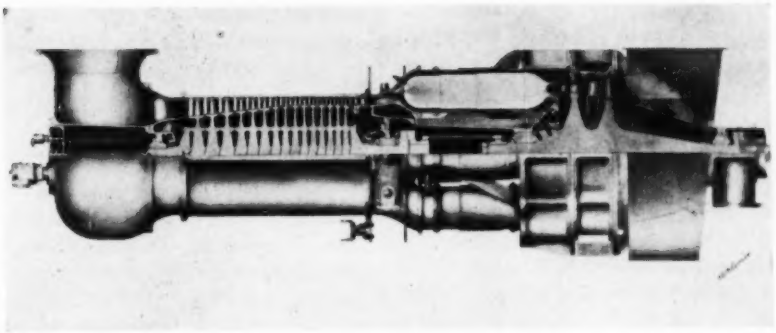
Diesel locomotives offer factors of importance to the railways' operating staffs. These included a high degree of reliability; a sustained efficiency over the whole range of locomotive working speeds; and sustained performance under changes of ambient temperature and altitude.

Reliability of the gas turbine cannot yet be claimed as high as that of the diesel. Indicating future prospects it may be said that experiments have already established that, when operated at 1000° F, the blade life of the gas turbine equals that of the steam turbine. Efficient locomotive operation, however, will involve operating temperatures approximating 1400° F. Limitations of pressure ratio and temperature presently limit the efficiency of the gas turbine to little more than half that of the diesel. Furthermore, while the efficiency of the latter is sustained at a relatively constant value over a wide range of loads, the gas turbine has much less efficiency at partial loads than at full load.

Output and efficiency are extremely sensitive to variations in temperature. Output increases as the air temperature to the compressor falls, a serious

"EMD diesel locomotive railroad engine being checked over by mechanics after installation on the diesel locomotive frame."





"Gas turbine power plant for locomotive. Shaded longitudinal semisection (March 1946 version). Cuts courtesy of General Electric."

disadvantage when the type of locomotive operation involves wide variations in ambient temperature conditions. To a lesser extent output and efficiency are affected by atmospheric pressure.

Economy

Substantial economic advantages to the railroads are obtained with diesels. These stem primarily from a lower cost: the use of relatively small quantities of suitable grades of liquid fuel; a great reduction in water costs; low overall maintenance costs; and, in intensive applications, lower fixed charges.

The gas turbine locomotive has not as yet substantiated claims that it can equal the diesel's economic advantage. Because of its ability to burn low-grade fuel oil, the cost of fuel per gal. for the turbine locomotive may be lower than that of diesel fuel. Reduced efficiency of the gas turbine may be expected to offset this advantage. Further, any wide-spread demand for low-grade fuel would tend to increase its price. The gas turbine shares with the diesel the reduction of the steam locomotive water costs and shows some slight savings on water cooling costs.

Claims for lower maintenance costs because of the rotary nature of the equipment are as yet unproven. It does seem probable that a lower lubricating oil consumption will be shown.

Since the prime mover constitutes only a small part of the total locomotive cost, fixed annual charges are likely to remain substantially the same for either type.

Public Amenity

Finally, public amentities such as cleanliness and the absence of smoke and reduction of noise can be mentioned with respect to diesels.

The gas turbine locomotive, while sharing the cleanliness of the diesel, will have offsetting disadvantages of a high and objectionable noise level and a hazard associated with the exhaust heat discharge.

Factual Comparison

Consider the known facts in relation to the diesel-electric locomotive and compare them with predictions being made for the gas turbine.

Locomotive Weight

Adhesion imposes a natural and positive limit to the amount of horsepower worthwhile installing on any given weight of locomotive. For a comfortable margin of adhesion without wheel slippage, the maximum tractive effort should not exceed approximately 20 per cent of the locomotive weight on drivers.

From considerations of the maximum ruling grade (generally of the order of 2 per cent) and the relation between the speed on the maximum grade and the speed on the level, basic factors, there is no advantage for general purpose railway use, in reducing the locomotive weight below 150 lb. per hp. of prime mover measured at the wheel. Locomotives for high speed passenger applications can, with advantage, have a higher hp. per unit weight, but such applications represent a relatively small percentage of total railway operations.

It is typical of current standard designs of diesel-electric locomotives that the prime mover represents approximately 15 per cent of the total locomotive weight. The General Motors 2-cycle engine, on a typical 1500-hp. locomotive, weighs only 30,000 of a total locomotive weight of 240,000 lbs. There is a little merit, therefore, in the potential lighter weight of the gas turbine.

Largely offsetting any potential reduction in prime mover weight is the increased weight of the fuel required due to lower efficiency. A typical 1500-hp. diesel locomotive has a fuel tank of 1200 gal. capacity. Including the weight of the tank this corresponds (at 10 lb. per gal.) to 12,000 lb. total. For the same mileage the corresponding tank with fuel on a gas turbine locomotive must weigh 28,000 lbs., an increase of 16,000 lbs. This weight, too, is variable which in turn creates adhesion problems.

Locomotive Cost

On a typical locomotive, the diesel engine cost represents only about 20 per cent of the total. Any saving, therefore, in prime mover cost will affect only a small proportion of the total. If power unit cost were halved, the complete locomotive cost would, therefore, only be reduced by 10 per cent.

Since the prime mover represents a relatively small proportion of the total locomotive cost, the annual debit for depreciation and interest on capital is not likely to be greatly different for either form of power.

Cost of Operation

For the purpose of this comparison the significant elements of cost are fuel, lubricants, and repairs; all others being substantially equal. In order to make a fair comparison, it is necessary to predicate a size of locomotive unit.

The most popular diesel locomotive unit is a 4-axle, 1500-hp, 230,000-lb. unit suitable for general traffic use, but in particular for the class of freight service constituting the bulk of the traffic. Such a unit is normally used

coupled 2, 3 or 4 in multiple, controlled from one operator's cab. Accordingly, such a unit is selected as a basis for comparison.

FUEL COST—As presently developed, all gas turbines are operating on either gas or liquid fuels, but there is substantial interest in the use of coal. This superimposes substantial engineering problems on those of the gas turbine itself: difficulties in powdering, removal of objectionable material such as grit, and moderating temperatures to prevent fly ash from melting and forming slag on the blading. Use of the gas turbine will be dictated, in large measure, by its economy—normally a combination of thermal efficiency and the unit cost of fuel.

It may be noted, however, that on the basis of both avaiability and cost, the differential between coal and fuel oil appears to be moving in favor of liquid fuel. Accordingly, in the following study, it is assumed that the gas turbine locomotive will operate on fuel oil.

The General Motors 567-B diesel engine so widely used in U. S. locomotive applications has a thermal efficiency at full load of not less than 35 per cent, sustained over a wide range of loads. Electrical transmission efficiency will be substantially the same for either the diesel or gas turbine locomotive.

No locomotive gas turbine within sight is likely to have a peak efficiency as high as 24 per cent, since examples at present in service have maximum known claimed efficiency of 18 per cent. However, this is a peak efficiency occurring only at the selected useful peak load. At less loads efficiency falls substantially and rapidly. For example, consumption at idling is approximately five times that of the corresponding diesel engine. All factors considered, it is reasonable to assert that the average thermal efficiency of the gas turbine—corresponding to a peak efficiency of 24 per cent—is not likely to exceed 15 per cent within the foreseeable future.

Therefore, fuel consumption will be in the same relationship as the respective thermal efficiencies (35/15) or 2-1/3 times that of the diesel locomotive.

Latest values of fuel consumption for many hundreds of 1500-hp. diesel locomotives is 1.8 gal. per locomotive unit mile. Currently the price of locomotive diesel fuel is approximately 10¢ per gal. Fuel cost is therefore 18¢ per locomotive unit mile.

Several variables must be considered in estimating the unit cost of fuel for a gas turbine locomotive. While it seems probable that a grade of bunker C fuel will be used, this covers an extremely wide range of fuels and only the better fractions are likely to be suitable. Improvements in refining processes will tend to reduce the availability of the unwanted and low price fractions. Unit prices vary widely depending on geographical location in relation to oil fields, transport costs, and the demands of local industry. With the above factors in mind, it is assumed for this comparison that bunker C fuel may be generally available in the suitable grades at 5½¢ per gal.

For the gas turbine locomotive, therefore, this corresponds to a fuel cost of 23¢ per locomotive unit mile.

COST OF LUBRICANTS—For our unit of comparison, the lubricant cost of many hundreds of existing diesels is 1.5¢ per unit mile.

There may be some justification for the claim that lower lubricant cost will be an advantage to the gas turbine. However, it must be remembered that lubricant cost includes generators, traction motors and running gear, much of which is common to both locomotive types.

There, it would appear generous in favor of the gas turbine to allow a lubricant cost of 0.5¢ per unit mile.

COST OF REPAIRS—Repair cost per locomotive unit mile for the chosen 1500-hp. example taken from records of many hundreds of diesel locomotives, is 10¢ total, of which 4½¢ relates to the prime mover and the remainder to electrical transmission equipment and running gear, common to either type. It is a claim as yet unproven, that the gas turbine repair costs will be lower than for the diesel engine.

In the case of the diesel, parts are produced in large quantities and at low cost. Maintenance operations proceed on a mileage basis and unexpected failures are usually confined to one cylinder, and repairs to which can generally be made with a minimum disturbance to the prime mover a a whole. On the other hand, failure of, say, an individual turbine or compressor blade, may strip a complete stage; the blades are expensive and renewal may involve substantial dismantling.

Therefore, it would seem generous to assume a 40 per cent reduction of the prime mover repair cost which will be only 2¢ per unit mile, a total of 8¢ for the complete unit, compared with 10¢ for the complete diesel.

Total costs of operations are summarized to obtain the following comparison:

Cost, Locomotive Unit Mile	Diesel (Actual)	Gas Turbine (Estimated)
Fuel	18.0¢	23.0¢
Lubricants	1.5¢	0.5¢
Repairs	10.0¢	8.0¢
Total	29.5¢	31.5¢

Operating Problems

There are also operating difficulties still to be solved for gas turbine locomotive applications. Variations in ambient temperature will cause substantial variations in the engine output. A temperature rise of 100° F may represent a power loss of 40 per cent.

It is necessary to study at least two sets of conditions. A railroad may have relatively constant daily conditions, but substantial differences of

Buyers' Guide Number Coming in June

ambient temperature between summer and winter, or a railroad may operate generally in hilly country where in a matter of hours the operating conditions may change substantially in temperature and altitude. In either case wide variation in power availability is undesirable. For the diesel locomotive these problems are solved.

Examples of other operating problems readily occur, such as fire risk due to high temperature exhaust on lines with timber-lined tunnels, structures or over bridges.

General Conclusion and Foward Policy

There seems little immediate prospect that the gas turbine will establish such outstanding economic advantages as to justify the premature claim that the proven economics of the diesel locomotive will be quickly surpassed. In addition, operational problems may take some years to solve.

A gas turbine locomotive would still retain all the electrical equipment and running gear of the existing diesel locomotive, representing perhaps 80 per cent of the whole in terms of initial cost and annual charges such as interest, depreciation, and maintenance.

The main features of the gas turbine, such as light weight and small size appear to have no particular advantage in the locomotive application.

In any case, it appears sensible to adopt a forward policy to protect the current investment in diesel-electric locomotives by concentrating developments in the field of gas turbine locomotives on a power unit which will exactly replace the existing diesel engine. If and when the gas turbine can be made to show superior advantages and economy, the power unit alone, representing only, say, 20 per cent of the cost of the locomotive, can then be substituted for the existing engine.

Such assurances should dispel any hesitations which may have been created in either railway or financial circles by premature and unjustified claims for the gas turbine which at this time cannot invalidate proven experience with the diesel-electric locomotives.

Cutting Welding Costs

Diesel fuel savings of 70 per cent and maintenance savings of 85 per cent resulted from the use of selenium rectifier welders during erection of a 2,000,000 gallon water tower for the City of Niagara Falls, New York, by the Pittsburgh-Des Moines Steel Company.

Fuel savings were made possible by the use of one diesel-driven generator to supply power for eight Westinghouse selenium rectifier welders. Formerly, eight separate engine-driven welding generators were used. Maintenance required on the single diesel engine was approximately the same as that required on each of the eight units previously used.

The diesel engine used to drive the generator supplying power to the eight selenium rectifier welders required 33 gallons of fuel per day. At 10 cents per gallon, the daily fuel costs ran $3.30. Previously, each of the single engine-driven welding generators required 15 gallons of fuel per day. For eight machines, a total of 120 gallons was required—or $12.00 per day for fuel.

These savings are partly attributable to the low standby power required by the selenium rectifier machines, since less fuel is consumed during idle time. In this erection job the welding duty cycle was relatively low.

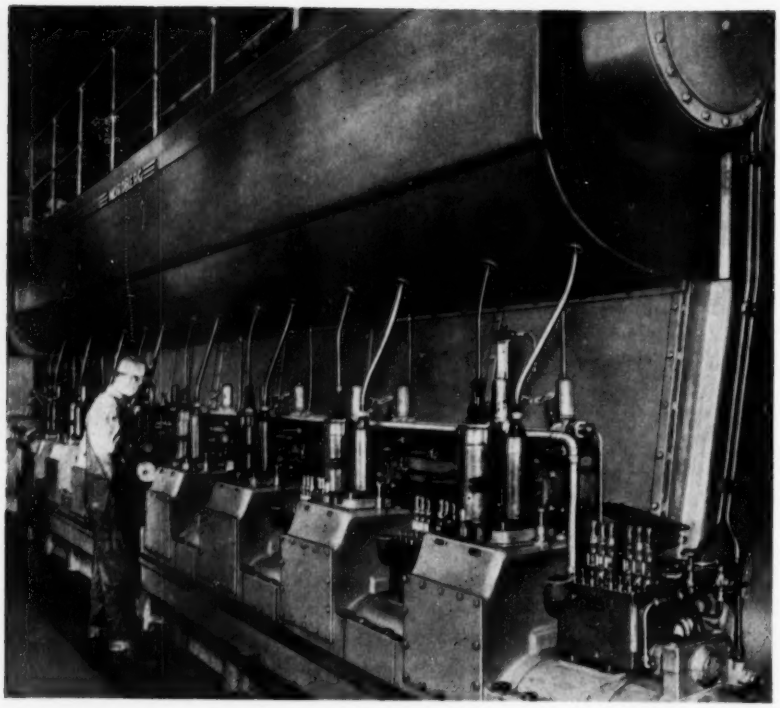
Eight Westinghouse type RA 400-ampere selenium rectifier welders, plus a 60-kw. generator driven by a 115-hp. diesel engine were used for this fabrication job, with a saving in initial cost of approximately 50 per cent. Formerly, eight 35-hp. diesel-driven welding generators of capacities equal to the selenium rectifier machines were used.

"Two million gallon water tower erected for city of Niagara Falls, New York."

Because of the high efficiency and low standby power requirements of the type RA machines, more individual welding units can be handled by a generator of given size, in the ratio of 8 to 6.

The single engine-driven generator and the eight selenium rectifier machines weigh approximately 62 per cent less than eight separate engine-driven welding generators. This resulted in a considerable saving in handling and shipping costs in transporting the equipment to the erection location.

"Selenium rectifier welders powered by diesel generator rig shown in background.



The 3400-hp. Duafuel Nordberg engine recently installed in the Phillipsburg, Kansas plant of the Western Light & Telephone Company.

Dual Fuel Engine in Kansas Utility

THE WESTERN Light & Telephone Co., one of the three largest public utilities in the state of Kansas, has greatly expanded its facilities for the generation of electric power. Diesels have long played an important part in this company's power activities and internal combustion units have had a major role in the expansion program. Recent installations at seven Kansas generating stations include two steam turbines, two oil-burning diesels, and four dual fuel engines.

One of the notable dual fuel installations was at Phillipsburg, Kansas, where a 3400-hp., 2-cycle Nordberg unit is now in regular service. This engine, one of the first of its type, burns natural gas at low pressure with a small quantity of oil as pilot fuel and can be switched instantly from dual fuel to full oil operation.

Western Light & Telephone is providing utility services to approximately 47,500 electric customers in Kansas and Missouri, 4500 water customers in Kansas, 4500 gas customers in Kansas and 48,900 telephone subscribers in Kansas, Missouri, Iowa and Oklahoma. Electric production has expanded steadily in recent years. Peak loads have risen from 19,000 kw. in 1943 to 42,000 in 1950 and total production has grown from 69,853,000 kw. hr. in 1943 to more than 150,000,000 kw. hr. for the full year of 1950. Total generating capacity has gone from 27,500 kw. to 50,500 kw. and diesel capacity from 10,050 kw. to 22,150 kw.

The use of numerous generating stations, strategically situated in the areas served, enables this utility to render highly dependable service and minimizes the danger of service interruption through transmission line failure. It is equally important, however, to produce power economically and the "Duafuel" engine is proving itself a good answer to the problem. The engine has only been operating on gas since July 7, 1950. According to company records it has generated over 4,000,000 kw. hr. up to December 1, 1950 and is averaging 9,703 cu. ft. gas (950 Btu. per cu. ft.) per kw. hr. at 86 per cent load. This indicates an operating efficiency of 37 per cent.

The Nordberg Duafuel is an eight cylinder engine of 21½ in. bore and 31 in. stroke with a rating of 3400 hp., 2410 kw. at 225 rpm. At the Phillipsburg altitude of 2000 feet the unit is rated 3330 hp., 2360 kw. Until recently there were no two-cycle engines as large as this which could be switched instantly from gas to oil or from oil to gas. Nordberg has a large number of big, two-cycle convertible gas engines operating successfully in the field but these units inject gas at high pressure and require several hours to switch to full diesel. With the engine at Phillipsburg, however, gas is used at low pressure and the engine can be changed from Duafuel to diesel by the simple movement of the control lever.

Gas reaches the plant at 48 to 50 lb. pressure, passes through a meter, a scrubber and then a regulator which reduces pressure to 20 lb. At this pressure it passes through an admission valve into the engine's gas header and then through an admission valve at each cylinder. The opening of the valves at the cylinders is accomplished hydraulically by individual actuator pumps controlled by the governor. The engine shuts down automatically if lube or pilot oil pressure fails. The pilot oil is injected by the same fuel pumps and injection nozzle used for full oil operation. The pumps are specially calibrated to meter accurately the small quantities of oil required for dual fuel service. The pilot charge is constant.

Fuel at Phillipsburg is trucked to the plant from a local refinery and stored in two tanks with a combined capacity of 44,000 gal. A motor-driven transfer pump sends the oil from storage through meters to underground

day tanks. Engine-driven supply pumps take oil from the day tanks through duplex filters.

Oil for bearing lubrication and piston cooling is circulated by an engine-driven pump and the circuit includes a shell-and-tube oil cooler. A motor-driven auxiliary lube pump cuts in automatically if oil pressure drops. Part of the lube is drawn from the sump by a motor-driven pump and put through an activated clay purifier from which it returns to the sump. Oil is supplied to the cylinders by an individual force-feed lubricator for each cylinder. So far it has not been necessary to add any oil to the crankcase supply. In the first three months of operation, the engine used 816 gal. of oil which figures to about 5840 hp. hr. per gal. of lube.

Scavenging air is drawn from outside the plant through an automatic self-cleaning filter and an intake silencer to the engine-driven blower. Exhaust gases vent through a vertical silencer.

A separate closed cooling system was installed with the new engine. One motor-driven centrifugal pump circulates soft water through the engine jackets and through a heat exchanger. A second similar pump puts raw water through the exchanger and an induced-draft cooling tower. City water, used for make-up, is treated in a zeolite softener before it is added to the closed circuit.

At the side of the engine is a gauge panel which includes an exhaust pyrometer, control switches for motor-driven engine auxiliary equipment, gauges and an alarm panel. Alarms sound and indicator lights go on if jacket water pressure, jacket water temperature, raw water pressure, lube pressure or fuel oil pressure go outside prescribed limits.

The big engine drives a 2500 kw., 3125 kva., 2400 volt generator with a v-belt driven exciter. A complete new switchboard was installed at the same time the new engine went in.

In any multi-plant utility system, maximum efficiency of an individual plant is necessarily subordinated to the efficiency of the system as a whole. Every week, an operating schedule detailing the hours and load of each generating unit is issued from operations headquarters in Great Bend, Kansas. (The chief administrative offices of the company are at Kansas City, Kansas.) For a typical week in October, 1950, the following operating schedule was ordered for the new engine:

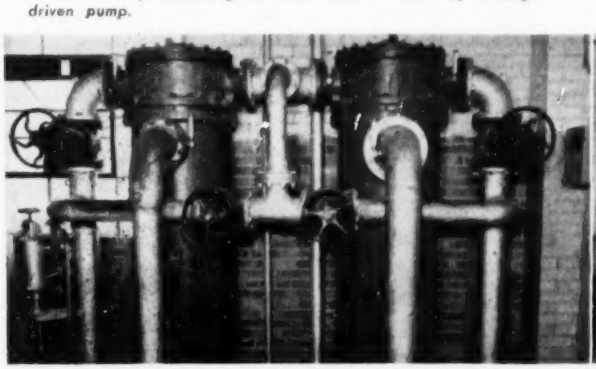
8 a.m.	*to 11 a.m.*	*1700kw.*
11 a.m.	*to 5 p.m.*	*1500kw.*
5 p.m.	*to 8 p.m.*	*2000kw.*
8 p.m.	*to 11 p.m.*	*1500kw.*

Some days the unit is required to pull additional loads up to capacity, depending upon system requirements and conditions. Every prime mover is, in effect, in competition with all the other available power sources in the utility's system and a regular 15-hour operating day speaks well for the relative economy of the new Phillipsburg engine. It is significant, too, that this expanding, progressive utility, with its long and intimate experience with internal combustion engines, should put so many of its expansion dollars into new dual fuel prime movers.

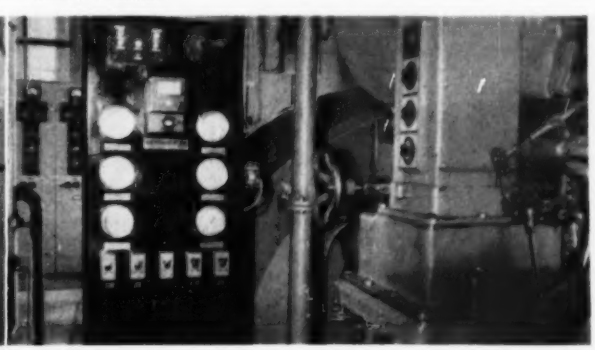
Table of Principal Equipment

Engine	Nordberg Manufacturing Co.
Generator	General Electric Co.
Lube Oil	Socony-Vacuum Oil Co., Inc.
Purifier	Honan-Crane Corp.
Oil Cooler	Ross Heater & Mfg. Co., Inc.
Lubricators	Manzel Inc.
Lube Oil Pump	Blackmer Pump Co.
Heat Exchanger	Ross Heater & Mfg. Co., Inc.
Cooling Water Pumps	Ingersoll Rand Co.
Cooling Tower	The Marley Co.
Fuel Oil	Consumer Co-op Association
Fuel Oil Transfer Pump	Geo. D. Roper Corp.
Fuel Meter	Neptune Meter Co.
Fuel Oil Filter	Wm. W. Nugent & Co., Inc.
Fuel Injection Pump	American Bosch Corp.
Gas	Kansas-Nebraska Natural Gas Co.
Scrubber	Blow-Knox
Gas Regulator	Emco
Actuator Pumps	American Bosch Corp.
Governors	Woodward Governor Co.
Alarm Panel	Nordberg Manufacturing Co.
Pyrometer	Illinois Testing Laboratories, Inc.
Alarms	Viking Instruments, Inc.
Gauges	Lonergan
Switchboard	General Electric Co.
Air Filters	American Air Filter Co., Inc.
Blower	Roots-Connersville Blower, Corp.
Exhaust Silencer	Maxim Silencer Co.
Intake Silencer	Maxim Silencer Co.

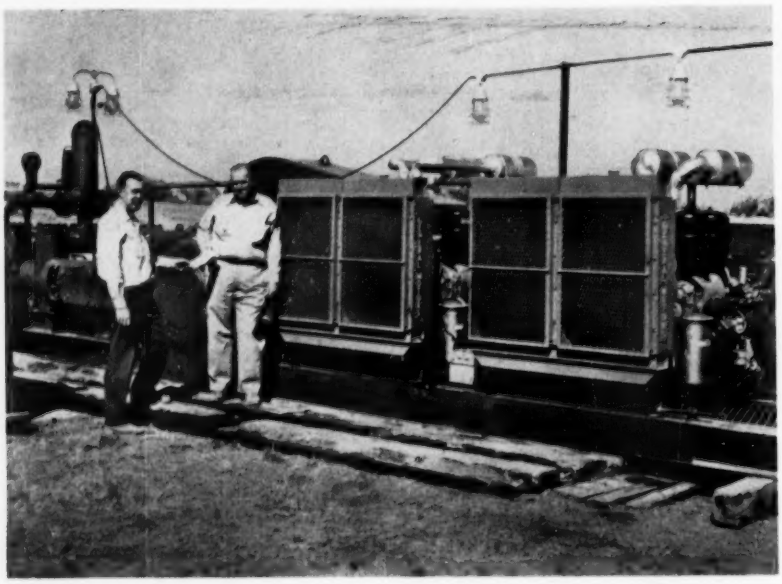
A pair of Ross heat exchangers cool jacket water and lubricating oil for 3400 hp. Nordberg. The lube oil is circulated by an engine driven pump.



Nordberg gage board located near the engine controls. Board contains an Alnor exhaust pyrometer, Viking alarm panels and control switches.



DIESEL BRIEFS



Multi-Engine Units

The flexibility of multi-engine internal combustion power units is clearly demonstrated in a mud pump compound in the service of the Fillmore Drilling Company of Bakersfield, California. The power plant consists of two GM Diesel "Twins" recently delivered to the drilling company by Lawless Brothers, Inc., GM Dealers.

The Fillmore unit is an Ideal C-250 mud pump powered by one "Twin 4" and one "Twin 6" GM diesel engine. Because any one engine or any combination of engines in these two multiple units can be started and clutched in at will, the company has diesel power available in eight different cylinder combinations—4, 6, 8, 10, 12, 14, 16 or 20.

Socony Crude Reserves

Socony-Vacuum's 1950 annual report showed that the company's domestic reserves increased by 111 million barrels during the year. This brings the company's total domestic reserves to an estimated 1491 million barrels. Gross production during 1950 was about 75 million barrels.

Last year saw the discovery by Socony-Vacuum and affiliated companies of a number of new fields, the most important being two in the Gulf of Mexico where the company has a joint venture with two other companies; in Beuregard Parish, La.; in the Parks Ranch area of Midland County, Texas, and in the Big Horn Basin of Wyoming.

New Diesel Plant

Construction will start soon on a new factory and office building in Crystal Lake, Ill., to house the Diesel Division of Harnischfeger Corporation. The factory, along with a smaller office structure, will occupy approximately 100,000 square feet on an 80-acre site on South Main Street. Production of diesel engines is slated to start October 1st.

Once under way, the plant will produce models ranging from one to six cylinders in size. Plant capacity will provide for a total of between 1200 and 1500 hp. every working day. This equals 10 six cylinder engines per day or one every 45 minutes.

The main office of the Diesel Division will be established at Crystal Lake. Karl Schoeppner is general manager.

Locomotive Heat Conservation

At the 57th annual meeting of The American Society of Heating and Ventilating Engineers Norman O. Kirkby, executive engineer, Vapor Heating Corp., spoke. He said that the production of steam on diesel and electric locomotives must be substituted for the steam locomotive boiler as a source of heat, or heat generating equipment must be used on individual railroad cars.

A new concept of steam generation resulted in the use of straight through steam generators on diesel locomotives on most American railroads. Heat release on these generators is in the neighborhood of 1,000,000 Btu's per cubic foot of combustion space, approximately 20 times normal practice.

These generators are continuous coil type steam generators, down fired with the same diesel fuel as is used on the power engines. Sizes range from 500 to 4800 pounds of steam per hour at varying pressures from 75 to 300 psi. Steam quality is in the neighborhood of 99.8 per cent.

Cummins Imports Steel

Steel from mills in Belgium and Germany is scheduled for use in Cummins diesels at Cummins Engine Co.

An initial Belgian steel shipment of 136,000 lbs. arrived in New York recently. This steel is being reshipped to forging plants in Lansing, Michigan and Indianapolis, Indiana, where rough forgings are to be made, after which these parts will be finish machined at the factory.

Cummins officials pointed out that these European purchases were made only after it became evident that its U. S. steel mill sources would not be able to supply its current total requirements for certain types of high quality steel.

DIESEL BRIEFS

Power Plant Operation Course

A three day Short Course for Diesel Power Plant Engineers will be held at Robert Allerton Park, Monticello, Illinois May 14-15-16. It is to be conducted by the Division of University Extension and the College of Engineering of the University of Illinois in cooperation with the Illinois Public Power Association.

The course will cover such topics as combustion, lubrication, fuels, governors, dual fuel engine-operation, maintenance-supercharging, scavenging and fire and accident prevention.

All meetings will be held, all meals will be served and all lodgings will be provided at Allerton House, Robert Allerton Park.

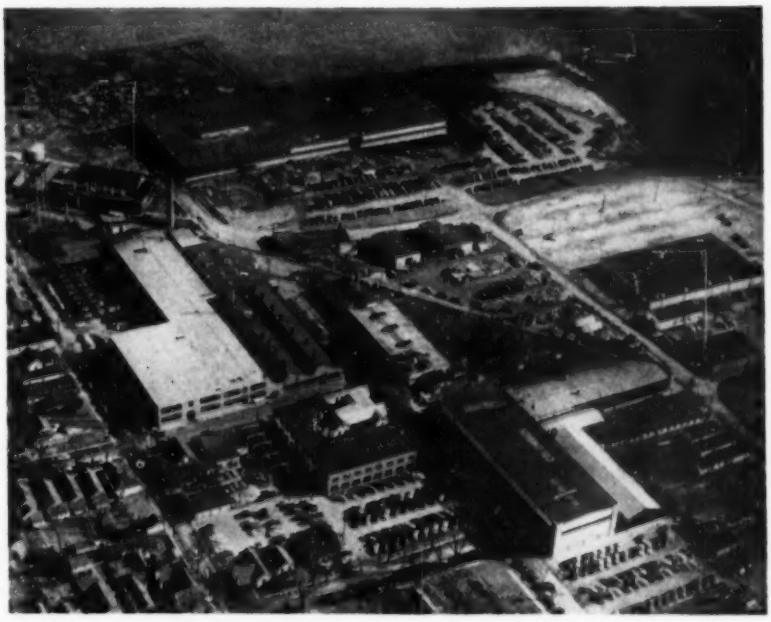
For information regarding housing and advance registration write to: Robert K. Newton, Supervisor of Engineering Extension, Rm. 205 Arcade Bldg., 713½ South Wright St., Champaign, Ill.

DEMA Summer Schools

Three summer courses for professors teaching diesel engineering have been set up by the Diesel Engine Manufacturers Association. The first course consists of five days at the American Bosch Corporation where interest will be centered on fuel injection equipment.

A second course on diesel fuels and lubricants is to be given at the Texas Company Beacon Laboratories. The third course, of two weeks duration, is at G.M.'s Detroit Diesel Engine Division and will be on engine assembly and disassembly, tune-up, diagnosis and dynamometer work on single and multiple units.

The first and third courses are limited to 12 men and the second to 15. Enrollment is partially completed indicating the desire of the educators to obtain practical experience as an aid in teaching.



Cummins Expansion

Cummins Engine Company, Inc. is expanding. The structure—upper center—nearing completion is the new Stores Center Building. Its 92,000 sq. ft. of floor space and an extension of 9600 sq. ft. to the 19-month old DD Fuel Pump Building—left center —will increase the size of the plant by more than 30 per cent.

With the completion of the new buildings, Cummins will have expended more than $6,000,000 for additional manufacturing facilities and for modernizing the Columbus plant, while at the same time increasing production capacity by 60 per cent.

Welding Clinic

A three-day welding clinic featuring demonstrations of welding techniques by the country's top technicians will be held on April 18, 19 and 20 at the Baltimore warehouse of Whitehead Metal Products Company, Inc.

Demonstrations will include motion pictures and actual welds performed by welding technicians on similar and dissimilar metals, covering the techniques of gas, electric, heli-arc, induction, gas and air, flame cutting and resistance welding.

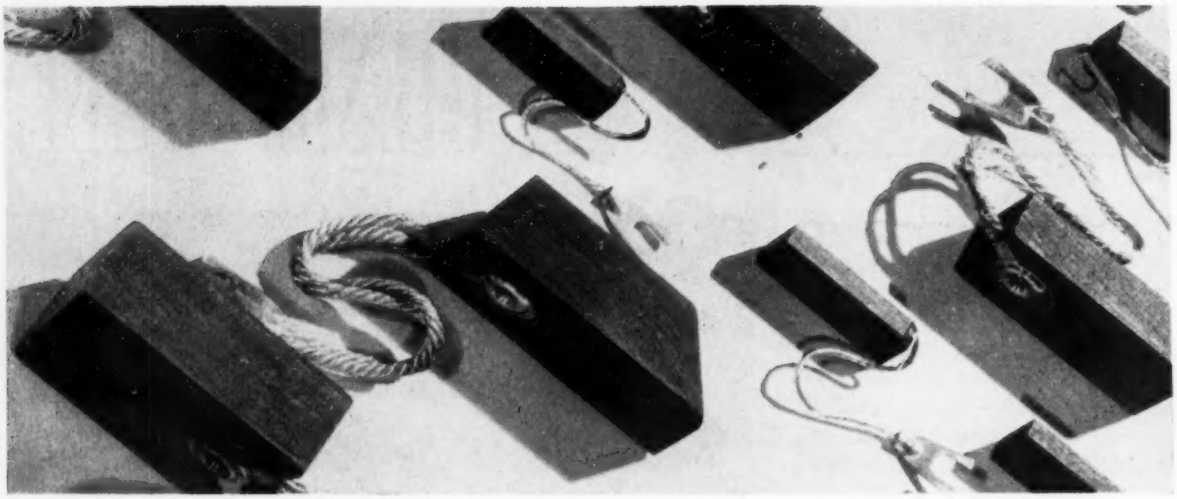
Metal users with special metal-joining problems are invited to bring in sample "welding problem" pieces or to mail their questions in advance to insure adequate demonstration time over the three-day "Clinic" period. They may address Whitehead Metal Products Company, Inc., 4300 East Monument St., Baltimore, Md.

Admission to the Welding Show is open to metal users, their representatives and employees, engineers and engineering students.

Tools to Service Cummins Diesels

Curtiss & Smith Manufacturing Corp. has been appointed as manufacturers and distributors of tools and equipment for servicing the complete line of Cummins diesel engines.

In addition to this new line, Curtiss & Smith manufactures tools for servicing G-M diesel engines, trucks, coaches, and hydraulic transmissions.



Brush Selection and Maintenance

ELECTRICAL machinery can be said to owe its present position to the development of the carbon brush. Brushes are found in practically every piece of electrical machinery and, without the use of carbon brushes, this machinery would long ago have been discarded because of difficulties inherent in the use of brushes made of other materials.

Because of the wide application of carbon brushes in diesel-electric locomotives, it is essential that those readers engaged in the operation and maintenance of this equipment have a good knowledge of the factors to consider when purchasing brushes and the steps to be taken to obtain optimum life and efficiency from each brush. While this article is of particular interest to railroad personnel, it is also applicable to other fields where electrical machinery is used.

Brush Functions

Brushes on commutating equipment have three primary functions: conduct electricity, control short circuit currents and maintain contact with the commutator. The brushes provide electrical contact between the external circuit and the windings of the rotating element of the machine, usually the commutator. They must function as a bearing material, maintaining firm contact with a rapidly revolving surface. Brushes also must control, within safe limits, the short-circuit current resulting from uncompensated voltage in the coil which is short-circuited by the brush during the interval of commutation.

When selecting brushes, these three functions must be kept in mind and the purchaser should make certain that the brushes will adequately fill the requirements. The brushes must not only fulfill these requirements but must do so without causing sparking of injurious intensity and without undue noise, serious commutator wear or excessive energy loss of either electrical or frictional origin.

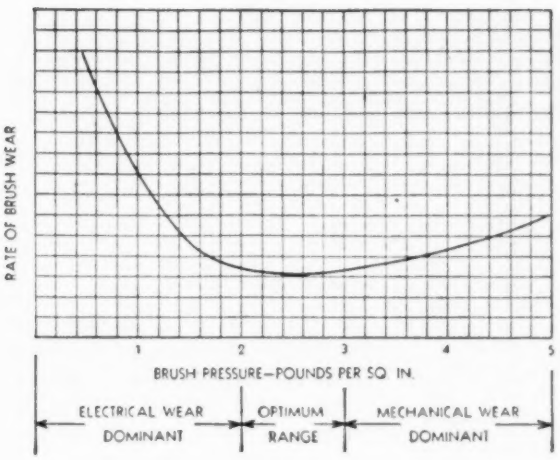
These latter considerations set up the further requirements that the brushes maintain a smooth commutator surface film of suitable characteristics. No material other than carbon is capable of meeting these exacting requirements in a satisfactory manner on machines of industrial voltage rating.

With an appreciation of brush functions, we can turn to the problems of maintenance and selection of brushes. Consideration of these problems, and application of correct procedures, will enable the user of electrical equipment to get better service and longer life from his brushes and equipment.

Maintenance

Good brush performance depends to a large extent on the care used in installing, fitting and adjusting the brushes before the machine is placed in service. It is essential that the machine in which the brushes are to be installed be properly adjusted since improper electrical or mechanical adjustment of the machine will inevitably affect the life and performance of the brush.

When installing a brush, several things must be considered. Spring tension in the brush holders must be correct, the holder should be clean and



Left — Curve correlating brush wear with brush pressure.

Below — A simple method of determining brush pressure.

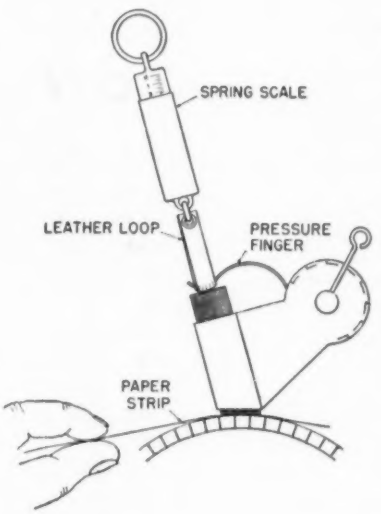
be the proper size for the brush, the brush should have the proper curvature to fit the commutator surface, and consideration should be given to proper spacing and positioning of the brush as well as to other aspects of operation. The several considerations which apply in brush installation are discussed here in an effort to help our readers to follow proper procedures and to do a better job.

Brush Pressure

Brush manufacturers have specific recommendations for brush pressure, depending on the grade of brush installed. Unfortunately, in the field, too many mechanics and maintenance men think that if two psi. is good, three psi. is better. This type of thinking is calculated to give brush manufacturers and their engineers gray hair, especially when complaints of brush breakage come rolling in. The proper tension for various brush grades and services has been studied by the manufacturer and it should be followed "to the pound."

Another tendency on the part of mechanics and operators is to keep the spring tension too low in order to reduce friction losses and brush wear. Unfortunately, this practice usually has just the opposite effect of that desired. Too light contact can be a source of sparking, injury to the commutator surface and undue brush wear.

Brush wear is not necessarily reduced by reducing brush pressure. At low pressures, electrical causes take over from mechanical causes as the primary source of brush wear. Too low brush tension allows the brush to hop off the commutator surface when the locomotive is running. When the brush is off the commutator, a spark jumps across the air gap to the brush, causing high current density in the brush and damaging the commutator surface. Additionally, the constant chattering of the brush causes mechanical failure because of impact loading. When the brush hops off the commutator and slaps back down, stresses are set up in the brush which can cause it to break.



It is also important to have all brushes adjusted to the same tension. Equal distribution of current among all the brushes on a machine requires that the pressure on all brushes be kept as nearly equal as possible.

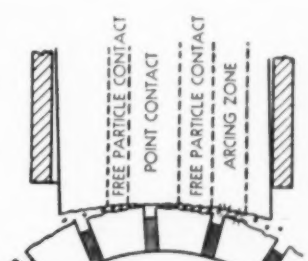
Brush tension can be checked with a small spring scale and a piece of paper. Slip the paper under the brush and attach the spring scale to the holder. Pull gently on the paper while lifting with the spring scale against the tension of the brush holder pressure arm in a direction parallel to the sides of the holder. Take the scale reading just as the paper can be pulled easily from under the brush and use this reading for all the brushes.

Brush Seating

Another prime consideration when installing brushes is that the brushes seat properly. This is essential to good brush operation, since improper seating can result in line contact between the brush and commutator with resulting high current density and brush overheating which can drastically reduce brush life.

The most common method of seating brushes is using sandpaper wrapped around the commutator. A coarse grade of paper is used at first and after the initial "cut" has been taken in the brush, a fine grade is used for the finishing cut. Time can be saved in this operation by increasing brush tension, taking care that the angle of the brush in the holder is the same as in actual operation.

Some manufacturers recommend the use of a brush seating stone rather than sandpaper. This is a fine grained free-wearing stone of special composition. It is held against the face of the commutator just before the brush to be seated and fine grains worn away from the stone slip under the brush face and grind it to the exact curvature of the armature.



EXAGGERATED DRAWING ILLUSTRATING NATURE OF CONTACT BETWEEN BRUSH AND COMMUTATOR

Both methods have their advantages and disadvantages. The brush seating stone could conceivably have an effect on the commutator surface film and the manufacturers of these tools have taken steps to insure that there is no harm done to this film when using the tool. The seating stone is somewhat easier to use than sandpaper. Another consideration is that, despite the small thickness of the sandpaper, it is possible to give the brush a slightly different curvature than the commutator surface, enough to leave a gap of several ten-thousandths of an inch at one or both edges of the brush when resting on the commutator. This slight gap may be enough to affect brush performance until it wears in to full span of contact.

Brush Holders

There are three classes of brush holders, reaction type, box type and clamp type. There are a great number of styles but the three classes mentioned cover just about every style of brush.

When installing new brushes, it is very important to see that the brush fits properly in the holder. Specifications for this fit are given by all manufacturers and these specs take into consideration several factors including wobbling, chattering, etc. By following the recommendations of the manufacturer, good fits and performance can be assured.

The reaction type holders are mounted to hold the brush at a considerable inclination from the radial. The main consideration as to fit involves only the brush width since the sides of the brush are not restricted. Tension is maintained in this brush by an arm and spring which causes the arm to press down on the brush top. The top of the brush is beveled in this type.

In box type holders, the brush fits in a small box in the holder. This box is sufficiently deep to hold the brush in a stable position on the commutator.

In this type, brush thickness is normally held between limits of exact nominal size and 0.004 in. under. Variations in the corresponding dimensions of the holder box should not exceed 0.003 to 0.004 in. with the minimum limit 0.002 in. over the nominal size. This allows a minimum clearance of 0.002 in. and a maximum clearance of 0.009 to 0.010 in.

Excessive clearance between the brush and the holder box allows the brush to tip and disturbs the contact with the commutator. This is especially true with reversing type series wound motors where the brushes are usually radial and there is no reaction effect to give stability to the brush position. Brush holder boxes should be inspected before new brushes are installed and, if badly worn, liners should be inserted to restore proper clearance.

In the clamp type holder the brush is rigidly secured in the holder and the pressure spring acts through the clamping element of the holder to press the brush on the commutator. This type is found on some small machines, but its use has largely been abandoned on larger machines and high speed commutators.

It is necessary that clearance between the commutator and the nearest portion of the brush support in reaction and box type holders be kept small. From 0.125 to 0.1875 in. clearance is sufficient for safe operation and close enough to give firm support to the brush in most cases. It is also necessary that the angular position of all brush holders with respect to the commutator be uniform. These conditions should be established before the brushes are installed.

Brush Spacing

The spacing between brushes around the commutator must be the same for optimum operation. If the spaces are unequal, currents will flow between brush studs of like polarity due to their difference in potential on generators or the difference in counter e.m.f. on motors. These currents may be high enough to cause serious heating of the commutator winding and excessive current density in the brushes.

An easy way to check brush spacing is to wrap a strip of paper around the commutator and mark the paper at the edge of each brush. Identify each brush arm by some convenient mark on the paper and remove the paper. Measure the distance between the marks and if there is uneven spacing, adjust the arms so they are spaced evenly.

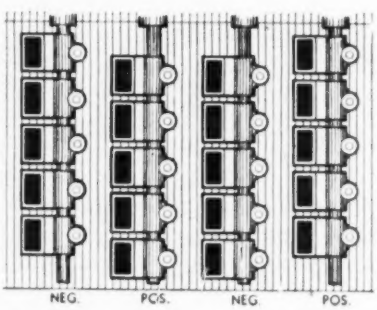
Brush Alignment

All the brushes on a brush arm should be accurately aligned with the commutator segments. This alignment can be checked by eye. In the event that some brushes are not in line, look for the cause and correct it. Some of the causes are turning of the brush holders, bending of the arm, etc.

Improper alignment increases the overall span of the brushes on the arm. The brush or brushes farthest out of line may be carrying a disproportionate share of the current load and thus will wear unevenly compared with the brushes which are trailing these leading brushes.

Stagger Brushes

In order to get maximum effectiveness from the machinery, it is necessary to stagger the brushes on the brush arms so that no part of the commutator surface is contacted by brushes of the same polarity more than by those of the other. This staggering results in a more uniform appearance of the commutator and, as mentioned, better performance.



General

By following the practices mentioned thus far, the operator will get optimum service and life from his brushes. Certain additional safeguards must be taken, some typical ones being given here.

It is very important that brushes be protected from dripping water. For example, one railroad was having trouble with brushes breaking in service. The trouble was encountered in those brushes which operated at the back end of the locomotive near the steam generator.

When the problem of brush breaking became very vexing, the railroad called in the brush manufacturer. After riding the locomotives for some time, it was discovered that an occasional drop of water from the condensate on the lines of the steam generator was dropping onto the brushes. When the cool water hit the hot brush, thermal stresses caused the brush to break. A shield placed over the equipment stopped brush breakage from this cause.

Another problem encountered by another railroad was brush breaking in equipment installed in the front of the locomotive. After investigation it was found that the jolt caused when the wheels of the locomotive hit the track joints was sufficient to make the brushes jump off the commutator and slap back down, with eventual brush breakage.

Brush Selection

In selecting brushes, the best method is to let the brush manufacturer do your worrying for you. He will recommend the proper brush grade for your application, a recommendation on which you can rely.

Consideration should be given to the material of the brush and to the shunts. The two basic causes of shunt trouble are disconnected shunts and crystallization of the shunt material.

Shunts become disconnected because they are either too long or too short to do the job. Make certain that the shunts are the proper length so that they are not always stretched or that they are not too long. Crystallization of the metal in the shunts, with eventual breakage, is a problem which has been partially solved and brush manufacturers are constantly improving the metal used for the shunts to minimize this difficulty.

There are a great many different varieties and sizes of brushes for various applications. This large number of brush types and sizes has been materially reduced by one manufacturer, National Carbon Division of Union Carbide and Carbon Corp. The standardization program is in operation and has achieved wide acceptance by brush users.

The program was put into effect by National Carbon after checking brush lengths, grades, bevels, shunt types, shunt lengths, and terminals. By determining what standards for these qualities could be set, the firm was able to greatly reduce the various types and sizes of brushes to a comparative few. This has resulted in the application of mass production techniques to brush production with resulting savings in brush cost, passed on to the customer.

The table shown gives the principal characteristics to be considered when choosing brushes, depending upon the type of application. For specific orders it is best, as mentioned previously, to check with the brush manufacturer's representative for guidance.

TYPE OF APPLICATION	PREFERRED TYPES OF BRUSHES	* PRINCIPAL CHARACTERISTICS TO BE CONSIDERED						
		Carrying Capacity	Maximum Surface Speed	Contact Drop	Riding Properties	Film Forming Properties	Polishing or Abrasive Action	Mechanical Strength
Slip Rings								
Synchronous motor field rings	Graphite and electrographitic	—	—	—	—	*	*	—
Turbo-alternator field rings	Low inertia graphite	—	*	—	*	—	—	—
Diesel-alternator field rings	Low inertia graphite	—	*	—	*	—	—	—
Induction motor	Electrographitic and metal-graphite	*	—	—	—	—	—	—
Synchronous converter	Metal-graphite	*	*	—	—	*	—	—
Commutating Type AC Motors								
Series—universal	Carbon, carbon-graphite and electrographitic	—	—	*	—	—	*	—
Single phase	Carbon-graphite and electrographitic	—	—	*	—	—	*	—
Polyphase	Electrographitic	*	—	*	—	—	—	—
Traction	Electrographitic	—	*	*	*	—	—	—
Low Voltage DC Units								
Plating generators	Metal-graphite	*	—	*	—	*	—	—
Farm lighting generators	Metal-graphite, graphite and electrographitic	*	—	*	—	—	—	—
Battery charging generators	Metal-graphite, graphite and electrographitic	*	—	*	—	—	—	—
Welding generators	Metal-graphite, graphite and electrographitic	*	—	*	*	—	—	—
Small motors, 30-60 volt	Graphite-carbon and low resistance electrographitic	—	—	*	—	—	*	—
Vehicle and industrial truck motors	Metal-graphite, graphite and electrographitic	*	—	*	—	—	—	—
Battery operated locomotives	Electrographitic and carbon-graphite	*	—	—	—	—	*	*
Aircraft equipment	Special grades designed for high altitude conditions	*	—	—	*	*	—	—
Standard Voltage DC Units								
Fractional horsepower motors	Carbon, electrographitic and graphite	—	—	*	—	—	*	—
Industrial motors—shunt and compound	Electrographitic, carbon-graphite, resin bonded graphite	*	—	*	—	—	*	—
Industrial motors—series	Electrographitic, carbon-graphite and carbon	—	—	—	—	—	*	*
Slow speed generators	Graphite-carbon, electrographitic and graphite	*	—	*	—	—	*	—
Large motors, generators and converters	Electrographitic and graphite	*	—	—	*	*	—	—
Diesel-electric locomotive generators	Electrographitic	*	*	—	*	*	—	—
Traction Motors—DC								
Non-interpole	Carbon-graphite and electrographitic	—	—	—	—	—	*	*
Interpole—low surface speed	Electrographitic and carbon-graphite	—	—	—	—	—	*	*
Interpole—high surface speed	Electrographitic	—	*	—	*	—	—	—
Diesel-electric locomotive motors	Electrographitic	—	*	—	*	—	—	*
Air brake compressor motors	Carbon and carbon-graphite	—	—	—	—	—	*	*

Engines for New Aluminum Plant

$12,000,000 Contract Awarded Cooper-Bessemer for Supercharged Gas Engines for Reynolds Metals Works

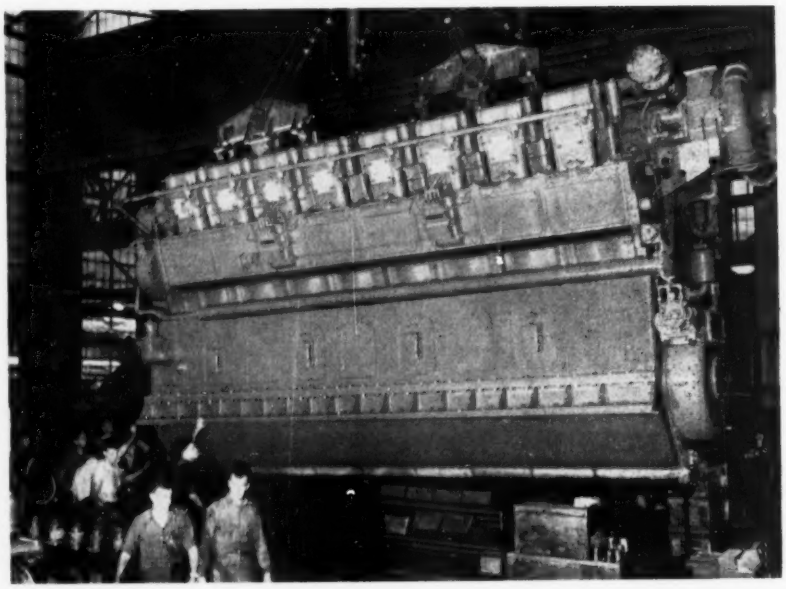
THE Cooper-Bessemer Corporation announced it has received an engine contract to build 40 of its largest, most modern supercharged gas engines for Reynolds Metals new, giant aluminum reduction plant to be located near Corpus Christi, Texas. This is the biggest single commercial engine order ever to be received by the firm and calls for the fastest possible construction of Cooper-Bessemer's 3700 horsepower Type LSV-16-SG engines. Engine deliveries are to start in August and are to be completed by January of 1952, according to Stanley E. Johnson, vice-president and general sales manager.

"Scheduled for completion in the early part of 1952, the power plants for this new aluminum reduction project will comprise the largest electric-generating project ever to be powered by internal combustion engines," explains Mr. Johnson. "In horsepower, the project will be considerably greater than any existing aluminum reduction power plant, providing 256,000 horsepower for aluminum reduction and general needs.

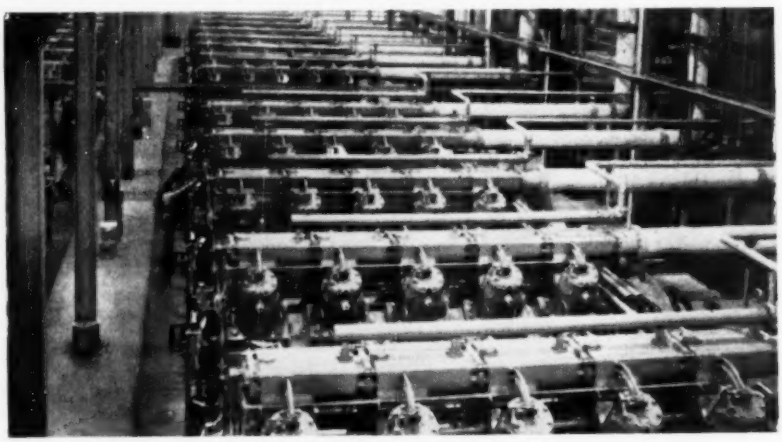
"The gas engines to be furnished are to be of the Type LSV-16-SG supercharged and spark ignited, developing 3700 hp. at 327 rpm. and at 135 lbs. bmep." explains Mr. Johnson.

Natural gas for fuel will be furnished from nearby independent fields. When the completed power plant is in full operation, natural gas fuel will be drawn at a rate of 48 million cubic feet per day, giving some idea of the size of this one operation alone.

As a result of the supercharged gas engine development, it has become possible to boost gas engine horsepower output 80 per cent while cutting fuel consumption as much as 30 per cent. Keeping in mind the vast quantities of natural gas to be consumed as fuel on this one power generating operation, the enormous savings in our natural resources effected by the firm's successful supercharging developments become obvious.



One of forty engines being built for the new Reynolds Metals plant. One engine room of earlier plant at Jones Mill, Ark., shown below, also has Cooper-Bessemer engines.



In the powering operation for this plant's needs, 9 of the LSV-16-SG units will drive 2500 kw., alternating current generators furnishing current at 4160 volts, 3 phase and 60 cycle. Thirty-one units will operate 2500 kw., direct current electrolytic reduction generators furnishing 3450 amperes at 725 volts nominal rating.

The expansion in this country's aluminum producing capacity is of course being accelerated by critical needs arising in today's emergency. In the production of aluminum, approximately two pounds of bauxite are needed to produce one pound of alumina. In turn, two pounds of alumina will produce one pound of aluminum metal. Throughout the reduction operations, the immense quantities of electric power to be generated by the new power plant, are a prime requirement for the electrolytic reduction.

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SYMBOL MEANINGS

M—Marine
S—Stationary
P—Portable or mobile
O—Own Manufacture
B—American Bosch
BS—Bendix-Scintilla
DM—Demco

A—Air starting
EL—Electric
G—Gasoline engine starting
H—Hand cranking
M—Mechanical blower
TC—Turbocharger

D—Direct reversing
S—Snow-Nabstedt
T—Twin Disc
C—Capitol
P—Paragon
W—Western Gear
F—Falk

American Locomotive Company
30 Church Street
New York, New York

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
9 x 10½	P	..	..	..	..	..	..	..	..	..	..	..	..	..
9 x 10½	P	..	..	..	..	..	..	..	..	..	..	..	..	..
12½ x 13	P	4	6	12½ x 13	660	700	B	EL	..	..	..	..	..	34000
12½ x 13-T	P	4	6	12½ x 13	1000	740	B	EL	TC	..	..	..	..	36000
12½ x 13	S	4	6	12½ x 13	540– 650	600–720	B	A	..	..	..	..	..	39100
12½ x 13	S	4	8	12½ x 13	720– 865	600–720	B	A	..	..	..	..	..	51500
12½ x 13-T	S	4	6	12½ x 13	810– 975	600–720	B	A	TC	..	..	..	..	40600
12½ x 13-T	S	4	8	12½ x 13	1080–1300	600–720	B	A	TC	..	..	..	..	53300

All stationary engines available as dual-fuel units with same ratings.

Baldwin-Lima-Hamilton Corp.
Hamilton, Ohio
Baldwin Engines

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
606-NA	M-S-P	4	6	12¾ x 15½	430– 875	360– 625	B-BS	Air*	..	D	159	60	91	28000
608-NA	M-S-P	4	8	12¾ x 15½	575–1165	360– 625	B-BS	Air*	..	D	195	60	91	36000
606-SC	M-S-P	4	6	12¾ x 15½	650–1315	360– 625	B-BS	Air*	TC	D	193	72	91	29000
608-SC	M-S-P	4	8	12¾ x 15½	825–1750	360– 625	B-BS	Air*	TC	D	232	72	91	37550
706-NA	M-S	4	6	17 x 20	710–1040	257– 375	B-BS	Air	..	D	231	85½	116¾	65100
708-NA	M-S	4	8	17 x 20	950–1380	257– 375	B-BS	Air	..	D	287	85½	116¾	84000
706-SC	M-S	4	6	17 x 20	1070–1560	257– 375	B-BS	Air	TC	D	259	98⅞	116¾	67000
708-SC	M-S	4	8	17 x 20	1425–2080	257– 375	B-BS	Air	TC	D	315	98⅞	116¾	86000

**Electric starting in locomotive application.*

Hamilton Engines

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
69SA	M-S-P	4	6	9 x 12	450	950	DM	A-EL	..	..	130	50¼	50½	18000
T69SA	M-S-P	4	6	9 x 12	900	950	DM	A-EL	TC	..	134	50¾	50¾	19500
89SA	M-S-P	4	8	9 x 12	600	950	DM	A-EL	..	..	157	50¼	50¾	22000
T89SA	M-S-P	4	8	9 x 12	1200	950	DM	A-EL	TC	..	161	50¾	50¾	24500
521SA	M-S	2	5	21½ x 27½	2250–2860	240– 277	B	A	..	D	267	80	148	170000
621SA	M-S	2	6	21½ x 27½	2700–3430	240– 277	B	A	..	D	304	80	148	200000
721SA	M-S	2	7	21½ x 27½	3150–4009	240– 277	B	A	..	D	341	80	148	228000
821SA	M-S	2	8	21½ x 27½	3600–4575	240– 277	B	A	..	D	378	80	148	256000
921SA	M-S	2	9	21½ x 27½	4050–5145	240– 277	B	A	..	D	415	80	148	285000
1021SA	M-S	2	10	21½ x 27½	4500–5720	240– 277	B	A	..	D	478	80	148	314000
1121SA	M-S	2	11	21½ x 27½	4950–6300	240– 277	B	A	..	D	515	80	148	342000
1221SA	M-S	2	12	21½ x 27½	5400–6860	240– 277	B	A	..	D	552	80	148	370000
424DA	M-S	2	4	24 x 36	4000	180	O	A	..	D	310	111	236	....
524DA	M-S	2	5	24 x 36	5000	180	O	A	..	D	356	111	236	441000
624DA	M-S	2	6	24 x 36	6000	180	O	A	..	D	402	111	236	514000
724DA	M-S	2	7	24 x 36	7000	180	O	A	..	D	447	111	236	588000
824DA	M-S	2	8	24 x 36	8000	180	O	A	..	D	492	111	236	661000
924DA	M-S	2	9	24 x 36	9000	180	O	A	..	D	538	111	236	735000
1024DA	M-S	2	10	24 x 36	10000	180	O	A	..	D	583	111	236	808000
1224DA	M-S	2	12	24 x 36	12000	180	O	A	..	D	674	111	236	955000

The prefix "T" denotes turbocharged engine. The suffix "DA" or "SA" indicates whether the engine is double or single acting. All models are direct reversible except the various executions of the 9SA. All engines are designed with open type combustion chambers. All 21½ x 27½ engines are available as dual-fuel units.

The Buda Company
Harvey, Illinois

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
2BD77	P	4	2	3⅞ x 4½	15	1800	B	EL	..	..	23	23	36	500
2BD77	S	4	2	3⅞ x 4½	13	1700	B	EL	..	..	41	23	46	795
2BDM77	M	4	2	3⅞ x 4½	13	1800	B	EL	..	S	37½	24	32	720
4BD153	P	4	4	3⅞ x 4½	33	2200	B	EL	..	..	31	20½	30	680
4BD153	S	4	4	3⅞ x 4½	29	2000	B	EL	..	..	51	23	48	875
4BDM153	M	4	4	3⅞ x 4½	32	2000	B	EL	..	S	46	24	32	840
6BD230	S	4	6	3⅞ x 4½	42	2000	B	EL	..	..	56	20½	49	985
6BL230	P	4	6	3⅞ x 4½	50	2300	B	EL	..	..	38½	23	38	850
6BDM230	M	4	6	3⅞ x 4½	48	2000	B	EL	..	S	56	24	32	1140
6BD273	P	4	6	3¾ x 4½	65	2000	B	EL	..	..	40	20½	29½	890
6BD273	S	4	6	3¾ x 4½	54	2000	B	EL	..	..	56	23	39	985
6BDM273	M	4	6	3¾ x 4½	55	2000	B	EL	..	S	56	24	33	1250
6DT317	S	4	6	3⅝ x 5½	56	1800	B	EL	..	..	43	23½	40	1650
6DT317	P	4	6	3⅝ x 5½	79	2300	B	EL	..	..	41½	27½	39	1150
6DTM317	M	4	6	3⅝ x 5½	73	2100	B	EL	..	T-S	66	29	44½	1795
6DT468	S	4	6	4¼ x 5½	75	1600	B	EL	..	..	71	29	58	2235
6DT468	P	4	6	4¼ x 5½	96	2000	B	EL	..	..	48	26	39	1245
6DTM468	M	4	6	4¼ x 5½	97	1800	B	EL	..	T-S	72	30½	48	2140
4DC645	S	4	4	5⅝ x 6½	80	1200	B	EL	..	..	78½	38	71	3380
6DA844	P	4	6	5¼ x 6½	162	1800	B	EL	..	..	58½	28	47	2630
6DA844	S	4	6	5¼ x 6½	153	1690	B	EL	..	..	103	38	64	4605
6DAM844	M	4	6	5¼ x 6½	156	1600	B	EL	..	T-S	77	30	41½	3700
6DAS844	S	4	6	5¼ x 6½	178	1600	B	EL	M	..	58½	32½	49	2895
6DASM844	M	4	6	5¼ x 6½	178	1600	B	EL	M	T-S	77	35	41½	4100
8DC1125	P	4	8	5¼ x 6½	196	1800	B	EL	..	..	73	30	45	3400
8DC1125	S	4	8	5¼ x 6½	160	1400	B	EL	..	..	110	46	73	5200
8DCM1125	M	4	8	5¼ x 6½	152	1400	B	EL	..	T-S	101	30	50	4500
8DCS1125	S	4	8	5¼ x 6½	198	1400	B	EL	M	..	73½	32½	45	3580
8DCSM1125	M	4	8	5¼ x 6½	188	1400	B	EL	M	T-S	101	35	50	4900
6DC1879	P	4	6	6¾ x 8¾	207	1000	B	A-EL	..	..	80	37	60	6925
6DC1879	S	4	6	6¾ x 8¾	196	1000	B	A-EL	..	..	119	48	82	8755
6DCM1879	M	4	6	6¾ x 8¾	196	1000	B	A-EL	..	T	109	36	64	8350
6DCS1879	P	4	6	6¾ x 8¾	230	1000	B	A-EL	M	..	122	48	83	7900
6DCSM1879	M	4	6	6¾ x 8¾	214	1000	B	A-EL	M	T	109	36	64	8700

(Buda Company Specifications continued on next page)

The Buda Company

(Continued from preceding page)

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. H.P.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
8DCM2505	M	4	8	6¾ x 8¾	261	1000	B	A-EL	..	T-S	162	35	64½	12400
8DC2505	S	4	8	6¾ x 8¾	261	1000	B	A-EL	..	..	158	62	91	12840
8DCS2505	S	4	8	6¾ x 8¾	350	1000	B	A-EL	M	..	163	62	91	13240
8DCSMR2505	M	4	8	6¾ x 8¾	350	1000	B	A-EL	M	S-W	137	49	68	13800

All engines have Lanova combustion system.

Caterpillar Tractor Co.
Peoria, Illinois

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
D397	S-P	4	V-12	5¾ x 8	500	1200	O	A-EL	M	..	113	51	78	11000
D397M	M	4	V-12	5¾ x 8	400	1200	O	A-EL	M	F	148	58	65	14000
D386	S-P	4	V-12	5¾ x 8	400	1200	O	A-EL	..	..	109	51	71	10770
D386M	M	4	V-12	5¾ x 8	320	1200	O	A-EL	..	F	148	58	60	13770
D375	S-P	4	V-8	5¾ x 8	355	1200	O	A-EL	M	..	89	51	78	8550
D375M	M	4	V-8	5¾ x 8	270	1200	O	A-EL	M	S	118	53	69	11350
D364	S-P	4	V-8	5¾ x 8	265	1200	O	A-EL	..	..	89	53	73	8370
D364M	M	4	V-8	5¾ x 8	215	1200	O	A-EL	..	S	118	53	64	11170
D17000	S-P	4	V-8	5¾ x 8	200	1000	O	G-EL-A	..	..	85	50	67	8000
D17000M	M	4	V-8	5¾ x 8	150	1000	O	G-EL-A	..	T	113	53	56	9538
D13000	S-P	4	6	5¾ x 8	150	1000	O	G-EL-A	..	..	85	50	67	5610
D13000M	M	4	6	5¾ x 8	120	1000	O	G-EL-A	..	T-S	120	47	54	7450
D8800	S-P	4	4	5¾ x 8	102	1000	O	G-EL-A	..	..	70	49	67	4600
D8800M	M	4	4	5¾ x 8	82	1000	O	G-EL-A	..	T-S	92	47	51	5530
D337	S-P	4	6	5⅛ x 6	250	2000	O	G-EL-A	M	..	72	36	57	3950
D326	S-P	4	6	5⅛ x 6	170	2000	O	G-EL-A	..	..	72	36	52	3850
D318	S-P	4	6	4½ x 5½	103	1600	O	G-EL	..	..	77	31	57	3100
D318M	M	4	6	4½ x 5½	80	1600	O	G-EL	..	T-S	87	35	44	3620
D315	S-P	4	4	4½ x 5½	70	1600	O	G-EL	..	..	60	30	50	2450
D315M	M	4	4	4½ x 5½	53	1600	O	G-EL	..	T-S	70	34	42	2930
D311	S-P	4	4	4 x 5	52	1700	O	G-EL	..	..	58	28	52	1800
D311M	M	4	4	4 x 5	38	1600	O	G-EL	..	T	65	34	38	2500

Marine engine Hp. is for continuous 24-hr. duty. All other hp., max. without radiator fan. Dimensions and weights: Marine engines include reduction and reverse gear. Heights are above propeller shaft. All other engines w/o radiator fan. Weights are approximate. Widths include sump pump handle extended, starting crank, etc. All engines have "Caterpillar" fuel system—solid injection, precombustion chamber type. D397 and D375 equipped with Roots blower. All engines available as "Caterpillar" Electric Sets.

Chicago Pneumatic Tool Co.
6 E. 44th Street
New York, N. Y.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
39CP	S	4	3	9 x 10½	142.5	720	BS	A	..	..	68	26	67	9590
49CP	S	4	4	9 x 10½	190	720	BS	A	..	..	72	31	67	10690
69CP	S	4	6	9 x 10½	285	720	BS	A	..	..	112	31	67	14240
89CP	S	4	8	9 x 10½	380	720	BS	A	..	..	140	33	67	17880
412CP	S	4	4	11 x 12	332	720	BS	A	..	..	106	47	95	21200
512CP	S	4	5	11 x 12	415	720	BS	A	..	..	124	55	95	25300
612CP	S	4	6	11 x 12	500	720	BS	A	..	..	143	55	95	31600
812CP	S	4	8	11 x 12	665	720	BS	A	..	..	178	68	95	35700
614CP	S	4	6	11 x 14¼	420	514	BS	A	..	..	143	55	95	32000
814CP	S	4	8	11 x 14¼	560	514	BS	A	..	..	178	68	95	36000
460CP	S	4	4	16 x 20	580	360	BS	A	..	..	171	85	125	62700
462CP	S	4	4	16 x 22	580	327	BS	A	..	..	171	85	125	62700
560CP	S	4	5	16 x 20	725	360	BS	A	..	..	197	85	125	70500
562CP	S	4	5	16 x 22	725	327	BS	A	..	..	197	85	125	70500
660CP	S	4	6	16 x 20	875	360	BS	A	..	..	223	85	125	78000
662CP	S	4	6	16 x 22	870	327	BS	A	..	..	223	85	125	78000
860CP	S	4	8	16 x 20	1160	360	BS	A	..	..	275	106	125	98700
862CP	S	4	8	16 x 22	1160	327	BS	A	..	..	275	106	125	98700
69CPS	S	4	6	9 x 10½	428	720	BS	A	TC	..	156	44	84	15740
89CPS	S	4	8	9 x 10½	570	720	BS	A	TC	..	184	58	84	19380
412CPS	S	4	4	11 x 12	500	720	BS	A	TC	..	128	47	113	23400
512CPS	S	4	5	11 x 12	620	720	BS	A	TC	..	146	55	113	27500
612CPS	S	4	6	11 x 12	750	720	BS	A	TC	..	164	55	113	31600
812CPS	S	4	8	11 x 12	1000	720	BS	A	TC	..	215	68	113	35700
614CPS	S	4	6	11 x 14¼	620	514	BS	A	TC	..	164	55	113	32000
814CPS	S	4	8	11 x 14¼	840	514	BS	A	TC	..	215	68	113	36000
460CPS	S	4	4	16 x 20	875	360	BS	A	TC	..	210	85	125	62700
462CPS	S	4	4	16 x 22	820	327	BS	A	TC	..	210	85	125	62700
560CPS	S	4	5	16 x 20	1060	360	BS	A	TC	..	236	106	125	70500
562CPS	S	4	5	16 x 22	1060	327	BS	A	TC	..	236	106	125	72700
660CPS	S	4	6	16 x 20	1310	360	BS	A	TC	..	262	106	125	78000
662CPS	S	4	6	16 x 22	1310	327	BS	A	TC	..	262	106	125	80300
860CPS	S	4	8	16 x 20	1750	360	BS	A	TC	..	320	116	125	98700
862CPS	S	4	8	16 x 22	1750	327	BS	A	TC	..	320	116	125	101200

Engines have open-combustion chamber. Stationary use. All engines can be furnished as dual-fuel units.

Clark Bros. Co., Inc.
Olean, New York

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
RAD2	S	2	2	14 x 14	200	330	B-BS	A	..	..	..	..	..	28700
RAD32	S	2	3	14 x 14	300	330	B-BS	A	..	..	..	..	..	33850
RAD4	S	2	4	14 x 14	400	330	B-BS	A	..	..	..	..	..	42700
RAD5	S	2	5	14 x 14	500	330	B-BS	A	..	..	..	..	..	52700
RAD6	S	2	6	14 x 14	600	330	B-BS	A	..	..	..	..	..	65550
RAD8	S	2	8	14 x 14	800	330	B-BS	A	..	..	..	..	..	70400
DG4	S	2	4	12½ x 16	380- 500	300- 400	B-BS	A	..	..	..	..	..	.....
DG5	S	2	5	12½ x 16	475- 675	300- 400	B-BS	A	..	..	..	..	..	.....
DG6	S	2	6	12½ x 16	570- 750	300- 400	B-BS	A	..	..	..	..	..	.....
DG8	S	2	8	12½ x 16	760-1000	300- 400	B-BS	A	..	..	..	..	..	.....
MD4	M	2	4	12½ x 16	400	315	B-BS	A	..	..	..	..	..	42000
MD6	M	2	6	12½ x 16	600	315	B-BS	A	..	..	..	..	..	56000

All engines have open type combustion chambers.

Climax Engine & Pump Mfg. Co.
Clinton, Iowa

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
D-148	S	4	2	4¼ x 5¼	18	1200	B	EL	..	..	32	26	44	1950
D-297	S	4	4	4¼ x 5¼	36	1200	B	EL	..	..	47	26	44	2950

Stationary use.

Continental Motors Corp.
Muskegon, Mich.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
GD-157	S	4	4	3⅝ x 4⅜	26.4	1800	B	EL	..	..	31 5/16	15¾	30¼	605
HD-260	S	4	4	3⅞ x 5½	41.6	1800	B	EL	..	..	33 9/16	21¾	35	840
TD-427	S	4	6	4⅛ x 4⅞	71.8	1800	B	EL	..	..	47 1/16	21¾	37½	1300
RD-572	S	4	6	4¾ x 5½	96.5	1800	B	EL	..	..	51 11/16	28	44 9/16	1845
TD-6421	P	4	6	4⅛ x 4⅞	111.8	2400	B	EL	..	..	46¾	20½	36 9/16	1270
RD-6572	P	4	6	4¾ x 5½	150	2200	B	EL	..	..	52½	20½	41 9/16	1785

Models designated for portable use are transportation engines with peak hp. ratings. All others are industrial or agricultural except HD-260 which is industrial only.

Cooper-Bessemer Corp.
Mount Vernon, Ohio

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
FW6	S	4	6	9 x 10½	360	900	BS	A	..	..	130	34 5/16	80	17800
FW6T	S	4	6	9 x 10½	680	900	BS	A	TC	..	176	34 5/16	80	18300
FW8	S	4	8	9 x 10½	485	900	BS	A	..	..	160	34 5/16	80	20300
FW8T	S	4	8	9 x 10½	900	900	BS	A	TC	..	207	34 5/16	80	20800
FV6	S	4	6	9 x 10½	360	900	BS	A	..	..	87	43 1/16	57 3/16	20000
FV6T	S	4	6	9 x 10½	680	900	BS	A	TC	..	109	43 1/16	57 3/16	21000
FV8	S	4	8	9 x 10½	485	900	BS	A	..	..	102	43 1/16	57 3/16	22000
FV8T	S	4	8	9 x 10½	900	900	BS	A	TC	..	124	43 1/16	57 3/16	27240
FV12	S	4	12	9 x 10½	800	900	BS	A	..	..	140	43 1/16	57 3/16	26000
FV12T	S	4	12	9 x 10½	1230	900	BS	A	TC	..	140	43 1/16	57 3/16	37880
FV16	S	4	16	9 x 10½	975	900	BS	A	..	..	165	43 1/16	57 3/16	32000
FV16T	S	4	16	9 x 10½	1650	900	BS	A	TC	..	165	43 1/16	57 3/16	46430
GS6	S	4	6	10½ x 13½	425	600	O	A	..	..	142½	37½	67¼	21500
GS6T	S	4	6	10½ x 13½	720	600	O	A	TC	..	174	37½	67¼	22250
GS8	S	4	8	10½ x 13½	565	600	O	A	..	..	175	37½	67¼	29500
GS8T	S	4	8	10½ x 13½	960	600	O	A	TC	..	206½	37½	67¼	30250
JS5	S	4	5	13 x 16	430	400	O	A	..	..	149	44¼	79 5/16	41000
JS6	S	4	6	13 x 16	580	450	O	A	..	..	171	44¼	79 5/16	44000
JS6T	S	4	6	13 x 16	975	450	O	A	TC	..	199½	44¼	79 5/16	45000
JS7	S	4	7	13 x 16	675	450	O	A	..	..	193	44¼	79 5/16	48000
JS8	S	4	8	13 x 16	770	450	O	A	..	..	210	44¼	79 5/16	51000
JS8T	S	4	8	13 x 16	1300	450	O	A	TC	..	238½	44¼	79 5/16	52000
LS6	S	4	6	15½ x 22	825	327	O	A	..	..	224	55 5/16	120	76000
LS6T	S	4	6	15½ x 22	1285	327	O	A	TC	..	251	55 5/16	120	77000
LS7	S	4	7	15½ x 22	960	327	O	A	..	..	248	55 5/16	120	91000
LS8	S	4	8	15½ x 22	1095	327	O	A	..	..	276	55 5/16	120	106000
LS8T	S	4	8	15½ x 22	1850	327	O	A	TC	..	299	55 5/16	120	107000
LSV12	S	4	12	15½ x 22	1650	327	O	A	..	..	252	68	117	194500
LSV12T	S	4	12	15½ x 22	2770	327	O	A	TC	..	300	68	117	197500
LSV16	S	4	16	15½ x 22	2190	327	O	A	..	..	307	68	117	232500
LSV16T	S	4	16	15½ x 22	3700	327	O	A	TC	..	355	68	117	237500
FV6MG	M	4	6	9 x 10½	400	1000	BS	A	..	O	171	43 1/16	57 3/16	19500
FV6MGT	M	4	6	9 x 10½	760	1000	BS	A	TC	O	171	43 1/16	57 3/16	20000
FV8MG	M	4	8	9 x 10½	540	1000	BS	A	..	O	186	43 1/16	57 3/16	23000
FV8MGT	M	4	8	9 x 10½	1000	1000	BS	A	TC	O	186	43 1/16	57 3/16	23000
FV12MG	M	4	12	9 x 10½	800	1000	BS	A	..	O	220	43 1/16	57 3/16	29300
FV12MGT	M	4	12	9 x 10½	1365	1000	BS	A	TC	O	255	43 1/16	57 3/16	30000
FV16MG	M	4	16	9 x 10½	1080	1000	BS	A	..	O	262	43 1/16	57 3/16	35500
FV16MGT	M	4	16	9 x 10½	1835	1000	BS	A	TC	O	303	43 1/16	57 3/16	36500
GS6DR	M	4	6	10½ x 13½	355	500	O	A	..	D	175	37½	67¼	34000
GS6DRT	M	4	6	10½ x 13½	510	500	O	A	TC	D	178	37½	67¼	36000
GS8DR	M	4	8	10½ x 13½	470	500	O	A	..	D	208	37½	67¼	42000
GS8DRT	M	4	8	10½ x 13½	680	500	O	A	TC	D	210	37½	67¼	44000
JS6DR	M	4	6	13 x 16	515	400	O	A	..	D	177	44¼	79 5/16	46000
JS6DRT	M	4	6	13 x 16	770	400	O	A	TC	D	177	44¼	79 5/16	50000
JS8DR	M	4	8	13 x 16	685	400	O	A	..	D	216	44¼	79 5/16	55000
JS8DRT	M	4	8	13 x 16	1030	400	O	A	TC	D	216	44¼	79 5/16	60000
LS6DR	M	4	6	15½ x 22	750	300	O	A	..	D	239	55 5/16	120	90000
LS6DRT	M	4	6	15½ x 22	1085	300	O	A	TC	D	239	55 5/16	120	91000
LS8DR	M	4	8	15½ x 22	1000	300	O	A	..	D	287	58 5/16	120	110000
LS8DRT	M	4	8	15½ x 22	1445	300	O	A	TC	D	287	55 5/16	120	111000
LSV12DR	M	4	12	15½ x 22	1500	300	O	A	..	D	243	68	117	190000
LSV12DRT	M	4	12	15½ x 22	2170	300	O	A	TC	D	263	68	117	191000
LSV16DR	M	4	16	15½ x 22	2000	300	O	A	..	D	298	68	117	217000
LSV16DRT	M	4	16	15½ x 22	2890	300	O	A	TC	D	341	68	117	219000

Engines have open combustion chamber. Models marked M for marine use only; all others can be furnished for either straight diesel or dual-fuel operation. All stationary models are available also as gas-diesels. Width is between bolt centers. Height is given above shaft.

Cummins Engine Company, Inc.
Columbus, Indiana

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
A-600	M-S-P	4	6	4 x 5	100	2200	O	EL	..	T	48	27	37	1440†
HR400	M-S-P	4	4	5⅛ x 6	110	1800	O	EL	..	T	42	30	47	1640†
JBS-600	P	4	6	4⅛ x 5	150	2500	O	EL	M	..	47	25	40	1545†
H600	M-S-P	4	6	4⅞ x 6	150	1800	O	EL	..	T	57	30	46	2395†
HR600	M-S-P	4	6	5⅛ x 6	165	1800	O	EL	..	T	57	30	46	2400†
HRBB-600	P	4	6	5⅛ x 6	175	2000	O	EL	..	..	61	30	49	2450†
HS600	S-P	4	6	4⅞ x 6	200	1800	O	EL	M	T	58	32	47	2580†
NH600	M-S-P	4	6	5⅛ x 6	200	2100	O	EL	..	T	59	41	63	2480†
NHH600	P	4	6	5⅛ x 6	200	2100	O	EL	..	..	64	55	23	2285†
HRS600	M-S-P	4	6	5⅛ x 6	225	1800	O	EL	M	T	58	32	47	2580†
NHS600	M-S-P	4	6	5⅛ x 6	275	2100	O	EL	M	C	59	41	61	2775
NHRS600	M-S-P	4	6	5⅛ x 6	300	2100	O	EL	M	C	59	41	61	2725†

(Cummins Engine Specifications continued on next page)

Cummins Engine Company, Inc.

(Continued from preceding page)

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. H.P.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
NHHS600	P	4	6	5⅛ x 6	275	2100	O	EL	M	..	64	55	23	2580†
NVH1200	M-S-P	4	12	5⅛ x 6	400	2100	O	EL	..	S	73	42	55	4550†
NVHS1200	M-S-P	4	12	5⅛ x 6	550	2100	O	EL	M	S	73	42	55	4550†
L600	M-S	4	6	7 x 10	250	1000	O	A-EL	..	C	92	44	58	7590*
LR600	M-S	4	6	7 x 10	300	1200	O	A-EL	..	C	92	44	58	7590*

*All engines have exclusive Cummins fuel system. All except, L-600 and LR-600 suitable for automotive and other portable applications. † Automotive weight with all accessory equipment; also approx. weight of stationary engine w/o radiator or clutch; and approx. weight of marine engine w/o reverse gear. * Stationary engine and approx. marine weight w/o reverse gear. Hp. ratings and rpm. are maximum ratings.*

Enterprise Engine & Foundry Co.
18th & Florida Streets
San Francisco, Calif.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
DM3	M-S	4	3	8 x 10	68– 100	450– 600	BS	A-EL	..	RR	54¾† – 83⅝*	42†	71⅝†	5500† – 7200*
DM13	M-S	4	3	8 x 10	100– 120	600– 750	BS	A-EL	..	RR	54¾† – 83⅝*	42†	71⅝†	5500† – 7200*
DM4	M-S	4	4	8 x 10	90– 130	450– 600	BS	A-EL	..	RR	66¾† – 99⅝*	42†	71⅝†	6520† – 8200*
DM14	M-S	4	4	8 x 10	130– 160	600– 750	BS	A-EL	..	RR	66¾† – 99⅝*	42†	71⅝†	6520† – 8200*
DM6	M-S	4	6	8 x 10	135– 200	450– 600	BS	A-EL	..	RR	90⅝† – 123⅝*	42†	71⅝†	9000† – 10400*
DM16	M-S	4	6	8 x 10	200– 240	600– 750	BS	A-EL	..	RR	90⅝† – 123⅝*	42†	71⅝†	9000† – 10400*
DX6	M-S	4	6	10½ x 12	180– 345	300– 550	BS	A	..	D	133⅝† – 175¾*	39	85¾	22000† – 28200*
DX16	M-S	4	6	10½ x 12	345– 375	551– 600	BS	A	..	D	133⅝† – 175¾*	39	85¾	22000† – 28200*
DX36	M-S	4	6	10½ x 12	275– 520	300– 550	BS	A	TC	D	162† – 175¾*	39	85¾	24000† – 29300*
DX316	M-S	4	6	10½ x 12	520– 565	551– 600	BS	A	TC	D	162† – 175¾*	39	85¾	24000† – 29300*
DG6	M-S	4	6	12 x 15	250– 465	250– 450	BS	A	..	D	156⅝† – 193⅝*	46¼	94⅝	30000† – 36600*
DG16	M-S	4	6	12 x 15	465– 615	451– 600	BS	A	..	D	156⅝† – 193⅝*	46¼	94⅝	30000† – 36600*
DG36	M-S	4	6	12 x 15	400– 695	250– 450	BS	A	TC	D	186† – 193⅝*	46¼	94⅝	33000† – 39700*
DG316	M-S	4	6	12 x 15	695– 925	451– 460	BS	A	TC	D	186† – 193⅝*	46¼	94⅝	33000† – 39700*
DG8	M-S	4	8	12 x 15	340– 615	250– 450	BS	A	..	D	190⅝† – 227⅝*	46¼	94⅝	37500† – 45800*
DG18	M-S	4	8	12 x 15	615– 820	451– 600	BS	A	..	D	190⅝† – 227⅝*	46¼	94⅝	37500† – 45600*
DG38	M-S	4	8	12 x 15	540– 925	250– 450	BS	A	TC	D	220† – 227⅝*	46¼	94⅝	41000† – 47750*
DG318	M-S	4	8	12 x 15	925–1230	451– 600	BS	A	TC	D	220† – 227⅝*	46¼	94⅝	41000† – 47750*
DQ6	M-S	4	6	16 x 20	500– 795	210– 327	BS	A	..	D	209½† – 271¾*	60	124⅝	70000† – 79000*
DQ16	M-S	4	6	16 x 20	795– 875	328– 360	BS	A	..	D	209½† – 271¾*	60	124⅝	70000† – 79000*
DQ36	M-S	4	6	16 x 20	800–1195	210– 327	BS	A	TC	D	227¼† – 271¾*	60	124⅝	75000† – 82200*
DQ316	M-S	4	6	16 x 20	195–1315	328– 360	BS	A	TC	D	227¼† – 271¾*	60	124⅝	75000† – 82200*
DQ8	M-S	4	8	16 x 20	675–1060	210– 327	BS	A	..	D	257½† – 319¾*	60	124⅝	90000† – 93000*
DQ18	M-S	4	8	16 x 20	1060–1170	328– 360	BS	A	..	D	257½† – 319¾*	60	124⅝	90000† – 93000*
DQ38	M-S	4	8	16 x 20	1080–1595	210– 327	BS	A	TC	D	275¼† – 319¾*	60	124⅝	1000001 – 106100*
DQ318	M-S	4	8	16 x 20	1595–1755	328– 360	BS	A	TC	D	275¼† – 319¾*	60	124⅝	1000001 – 106100*

*Engines have open combustion chamber. All models suitable for Marine use. † Stationary. * Marine. On DM series add 4½ in. for marine width and subtract 7⅞ in. for marine height. RR–Reverse and reduction gear make not known.*

Fairbanks, Morse & Company
600 S. Michigan Avenue
Chicago, Ill.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
31A6¼	M-S-P	2	5	6¼ x 9	150	720	O	A	..	D	..	..	..	..
31A6¼	M-S-P	2	6	6¼ x 9	180	720	O	A	..	D	..	..	..	..
31A6¼	M-S-P	2	7	6¼ x 9	210	720	O	A	..	D	..	..	..	..
31A6¼	M-S-P	2	8	6¼ x 9	240	720	O	A	..	D	..	..	..	..
31A8½	S-P	2	5	8½ x 11½	300	514	O	A	..	..	..	..	..	..
31A8½	S-P	2	6	8½ x 11½	360	514	O	A	..	..	..	..	..	..
31A8½	S-P	2	7	8½ x 11½	420	514	O	A	..	..	..	..	..	..
31A8½	S-P	2	8	8½ x 11½	480	514	O	A	..	..	..	..	..	..
31A8½	M	2	5	8½ x 11½	275	525	O	A	..	D	..	..	..	..
31A8½	M	2	6	8½ x 11½	330	525	O	A	..	D	..	..	..	..
31A8½	M	2	7	8½ x 11½	385	525	O	A	..	D	..	..	..	..
31A8½	M	2	8	8½ x 11½	440	525	O	A	..	D	..	..	..	..
31A18	S	2	6	18 x 27	2100	277	O	A	..	..	..	..	..	..
31A18	S	2	8	18 x 27	2800	277	O	A	..	..	..	..	..	..
31A18	S	2	10	18 x 27	3500	277	O	A	..	..	..	..	..	..
32E12	S	2	2	12 x 15	120	360	O	A	..	..	..	..	..	..
32E12	S	2	3	12 x 15	180	360	O	A	..	..	..	..	..	..
32E14	S	2	2	14 x 17	150	300	O	A	..	..	..	..	..	..
32E14	S	2	3	14 x 17	225	300	O	A	..	..	..	..	..	..
32E14	S	2	4	14 x 17	300	300	O	A	..	..	..	..	..	..
32E14	S	2	5	14 x 17	375	300	O	A	..	..	..	..	..	..
32E14	S	2	6	14 x 17	450	300	O	A	..	..	..	..	..	..
33F12	S	2	5	12 x 15	500	400	O	A	..	..	..	..	..	..
33F12	S	2	6	12 x 15	600	400	O	A	..	..	..	..	..	..
33E14	S	2	5	14 x 17	575	300	O	A	..	..	..	..	..	..
33E14	S	2	6	14 x 17	690	300	O	A	..	..	..	..	..	..
33E14	S	2	7	14 x 17	805	300	O	A	..	..	..	..	..	..
33F16	S	2	4	16 x 20	800	300	O	A	..	..	..	..	..	..
33F16	S	2	5	16 x 20	1000	300	O	A	..	..	..	..	..	..
33F16	S	2	6	16 x 20	1200	300	O	A	..	..	..	..	..	..
33F16	S	2	7	16 x 20	1400	300	O	A	..	..	..	..	..	..
33F16	S	2	8	16 x 20	1600	300	O	A	..	..	..	..	..	..
33F16	S	2	10	16 x 20	2000	300	O	A	..	..	..	..	..	..
37F12	M	2	5	12 x 15	500	400	O	A	..	D	..	..	..	..
37F12	M	2	6	12 x 15	600	400	O	A	..	D	..	..	..	..
37E14	M	2	5	14 x 17	575	300	O	A	..	D	..	..	..	..
37E14	M	2	6	14 x 17	690	300	O	A	..	D	..	..	..	..
37E14	M	2	7	14 x 17	805	300	O	A	..	D	..	..	..	..
37F16	M	2	5	16 x 20	1000	300	O	A	..	D	..	..	..	..
37F16	M	2	6	16 x 20	1200	300	O	A	..	D	..	..	..	..
37F16	M	2	7	16 x 20	1400	300	O	A	..	D	..	..	..	..
37F16	M	2	8	16 x 20	1600	300	O	A	..	D	..	..	..	..
37F16	M	2	10	16 x 20	2125	300	O	A	..	D	..	..	..	..
38D8⅛	M-S-P	2	4	8⅛ x 10	640	720	O	A	..	D	..	..	..	..
38D8⅛	M-S-P	2	5	8⅛ x 10	800	720	O	A	..	D	..	..	..	..
38D8⅛	M-S-P	2	6	8⅛ x 10	960	720	O	A	..	D	..	..	..	..
38D8⅛	M-S-P	2	8	8⅛ x 10	1280	720	O	A	..	D	..	..	..	..
38D8⅛	M-S-P	2	10	8⅛ x 10	1600	720	O	A	..	D	..	..	..	..
38D8⅛	M-S-P	2	12	8⅛ x 10	1920	720	O	A	..	D	..	..	..	..
45B3¼	M-S-P	4	1	3¼ x 4	5¼	1800	O	H-EL	..	..	..	..	..	..
45B4¼	M-S-P	4	1	4¼ x 4½	10½	1800	O	H-EL	..	..	..	..	..	..
48A$_0$	M-S-P	4	1	3 x 4	3½	1800	O	H-EL	..	S-T	..	..	..	..
48A4	M-S-P	4	1	4 x 5	10	1800	O	H-EL	..	S-T	..	..	..	..
48A4¼	M-S-P	4	1	4¼ x 5	11	1800	O	H-EL	..	S-T	..	..	..	..
48A4	M-S-P	4	2	4 x 5	20	1800	O	H-EL	..	..	..	..	..	..

(Fairbanks-Morse Specifications continued on next page)

Fairbanks, Morse & Company

(Continued from preceding page)

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weigh Lb.
48A4¼	M-S-P	4	2	4¼ x 5	22	1800	O	H-EL	..	S-T	..	..	..	..
48A4	M-S-P	4	3	4 x 5	30	1800	O	H-EL	..	S-T	..	..	..	..
48A4¼	M-S-P	4	3	4¼ x 5	34	1800	O	H-EL	..	S-T	..	..	..	..
48A4	M-S-P	4	6	4 x 5	61	1800	O	EL	..	S-T	..	..	..	..
48A4¼	M-S-P	4	6	4¼ x 5	67	1800	O	EL	..	S-T	..	..	..	..
49A4½	M-S-P	2	1	4½ x 5½	20	1200	O	EL	..	S-T	..	..	..	..
49A4½	M-S-P	2	2	4½ x 5½	40	1200	O	EL	..	S-T	..	..	..	..
49A4½	M-S-P	2	3	4½ x 5½	60	1200	O	EL	..	S-T	..	..	..	..
49A4½	M-S-P	2	4	4½ x 5½	80	1200	O	EL	..	S-T	..	..	..	..
49A4½	M-S-P	2	6	4½ x 5½	120	1200	O	EL	..	S-T	..	..	..	..

Engines have open combustion chamber. Models 38D are opposed-piston type.

Fulton Iron Works Company
St. Louis, Missouri

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
BGS	S	4	5	17½ x 24½	765	257	O	A	..	..	..	..	..	104000
BGS	S	4	5	17½ x 24½	825	277	O	A	..	..	..	..	..	104000
BGSS	S	4	5	17½ x 24½	1145	257	O	A	TC	..	..	..	..	106000
BGSS	S	4	5	17½ x 24½	1235	277	O	A	TC	..	..	..	..	106000
BGS	S	4	6	17½ x 24½	915	257	O	A	..	..	..	..	..	121280
BGS	S	4	6	17½ x 24½	990	277	O	A	..	..	..	..	..	121280
BGSS	S	4	6	17½ x 24½	1375	257	O	A	TC	..	..	..	..	123300
BGSS	S	4	6	17½ x 24½	1480	277	O	A	TC	..	..	..	..	123300
BGS	S	4	7	17½ x 24½	1070	257	O	A	..	..	..	..	..	138650
BGS	S	4	7	17½ x 24½	1155	277	O	A	..	..	..	..	..	138650
BGSS	S	4	7	17½ x 24½	1600	257	O	A	TC	..	..	..	..	141500
BGSS	S	4	7	17½ x 24½	1730	277	O	A	TC	..	..	..	..	141500
BGS	S	4	8	17½ x 24½	1220	257	O	A	..	..	..	..	..	156930
BGS	S	4	8	17½ x 24½	1320	277	O	A	..	..	..	..	..	156930
BGSS	S	4	8	17½ x 24½	1830	257	O	A	TC	..	..	..	..	160000
BGSS	S	4	8	17½ x 24½	1980	277	O	A	TC	..	..	..	..	160000
KS	S	4	6	24 x 28	1725	225	O	A	..	..	..	..	..	220000
KS	S	4	6	24 x 28	1970	257	O	A	..	..	..	..	..	220000
KS	S	4	6	24 x 28	2590	225	O	A	TC	..	..	..	..	222000
KS	S	4	6	24 x 28	2960	257	O	A	TC	..	..	..	..	222000
KSS	S	4	8	24 x 28	2300	225	O	A	..	..	..	..	..	280000
KSS	S	4	8	24 x 28	2630	257	O	A	..	..	..	..	..	280000
KSS	S	4	8	24 x 28	3455	225	O	A	TC	..	..	..	..	282000
KSS	S	4	8	24 x 28	3945	257	O	A	TC	..	..	..	..	282000

Normally aspirated engines are designated BGS and KS types. Supercharged engines are designated BGSS and KSS types. Dual-fuel normally aspirated engines are designated BGSD and KSD types. Dual-fuel supercharged engines are designated BGSSD and KSSD types.

General Motors Corporation
Cleveland Diesel Engine Division
Cleveland, Ohio

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. H.P.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
3-268A*	S-M	2	3	6½ x 7	(100kw*)	1200	O	E-L	..	..	107¾	38½	64⅜	8050*
4-268A†	S-M	2	4	6½ x 7	250	1300	O	EL-A	..	F	132¾	37¼	56	9200†
4-268A*	S-M	2	4	6½ x 7	(150 kw*)	1200	O	EL	..	..	120	40	65	10500*
6-268A†	S-M	2	6	6½ x 7	375	1300	O	EL-A	..	F	157⅜	39⅜	63¼	11200†
6-268A*	S-M	2	6	6½ x 7	(200 kw*)	1200	O	EL	..	..	152	42	71¾	14470*
7-268A†	S-M	2	8	6½ x 7	500	1300	O	EL-A	..	F	178	39½	63¼	13150†
8-268A*	S-M	2	8	6½ x 7	(300 kw*)	1200	O	EL	..	..	174	46	71¾	15380*
6-278A†	S-M	2	6	8¾ x 10½	615	750	O	EL-A	..	F	172¾	53¾	99¾	26300†
6-278A*	S-M	2	6	8¾ x 10½	(400 kw*)	750	O	EL	..	..	157	53	95½	27400*
8-278A†	S-M	2	8	8¾ x 10½	820	750	O	EL-A	..	F	194	53¾	99¾	31500†
8-278A*	S-M	2	8	8¾ x 10½	(500 kw*)	750	O	EL	..	..	183	53	95½	32600*
12-278A†	S-M	2	12	8¾ x 10½	1230	750	O	EL-A	..	F	258 1/16	57	109⅞	41700†
12-278A*	S-M	2	12	8¾ x 10½	(750 kw*)	750	O	EL	..	..	224	60	105⅞	42000*
16-278A†	S-M	2	16	8¾ x 10½	1640	750	O	EL-A	..	F	318	69	109⅞	53500†
16-278A*	S-M	2	16	8¾ x 10½	(1000 kw*)	750	O	EL	..	..	279	72	105⅞	52300*

***Entries so marked refer to models supplied as D.C. generating sets, in which cases ratings under column "Cont. H.P." is given in kilowatts and weights are for entire generating set assembly.**
†Entries so marked refer to models supplied as propulsion engines, in which cases weights include reverse and reduction gearing.

General Motors Corporation
Detroit Diesel Engine Division
Detroit, Michigan

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
2-71	M*	2	2	4¼ x 5	54	2000	O	EL	M[1]	S	51	30	37	1300
2-71	M†	2	2	4¼ x 5	47	1800	O	EL	M[1]	S	51	30	37	1300
2-71	S-P	2	2	4¼ x 5	65**	2000	O	EL	M[1]	..	31	27⅝	35⅝	960
3-71	M*	2	3	4¼ x 5	96	2000	O	EL	M[1]	O	56⅛	32 1/16	40¼	2020
3-71	M†	2	3	4¼ x 5	68	1800	O	EL	M[1]	O	56⅛	32 1/16	40¼	2020
3-71	S-P	2	3	4¼ x 5	100**	2000	O	EL	M[1]	..	37⅛	29½	39 1/16	1480
4-71	M*	2	4	4¼ x 5	129	2000	O	EL	M[1]	O	62	33¾	40¼	2410
4-71	M†	2	4	4¼ x 5	92	1800	O	EL	M[1]	O	62	33¾	40¼	2410
4-71	S-P	2	4	4¼ x 5	133**	2000	O	EL	M[1]	..	42⅛	29½	40 1/16	1720
6-71	M*	2	6	4¼ x 5	195	2000	O	EL	M[1]	O	73⅝	33½	40¼	2645
6-71	M†	2	6	4¼ x 5	140	1800	O	EL	M[1]	O	73⅝	33½	40¼	2645
6-71	S-P	2	6	4¼ x 5	200**	2000	O	EL	M[1]	..	54 1/16	29½	41¾	2100
Twin 4	S-P	2	8	4¼ x 5	267**	2000	O	EL	M[1]	..	68¼	56	58	4700
Twin 6	M*	2	12	4¼ x 5	390	2000	O	EL	M[1]	O	79½	56	56⅝	6400
Twin 6	M†	2	12	4¼ x 5	280	1800	O	EL	M[1]	O	79½	56	56⅝	6400
Twin 6	S-P	2	12	4¼ x 5	400**	2000	O	EL	M[1]	..	79¾	56	58	5440
Tandem Twin 6	M*	2	12	4¼ x 5	390	2000	O	EL	M[1]	O	129	37¼	57	7550
Tandem Twin 6	M†	2	12	4¼ x 5	280	1800	O	EL	M[1]	O	129	37¼	57	7550
Quad 6	M*	2	24	4¼ x 5	780	2000	O	EL	M[1]	O	128	56	54⅛	12600
Quad 6	M†	2	24	4¼ x 5	560	1800	O	EL	M[1]	O	128	56	54⅛	12600
Quad 6	S-P	2	24	4¼ x 5	800**	2000	O	EL	M[1]	..	174	56⅞	68⅝	12065
6-110	M*	2	6	5 x 5.6	265	1800	O	EL	M[1]	O	79¼	31	47⅞	4000
6-110	M†	2	6	5 x 5.6	230	1600	O	EL	M[1]	O	79¼	31	47⅞	4000
6-110	S-P	2	6	5 x 5.6	275**	1800	O	EL	M[1]	..	69¾	31¾	49	4000

** Pleasure craft: Rated SHP. † Work boat: Continuous ship. ** Rated BHP, basic engine. Weights and dimensions of marine engines vary with gear selected. Industrial engines available with torque converters. [1] Pressure scavenging.*

General Motors Corporation
Electro-Motive Division
La Grange, Ill.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
6-567A	P	2	6	8 1/16 x 10	600	800	O	EL	..	..	114 1/16	64 7/8	84 1/16	14250
8-567B	P	2	8	8 1/16 x 10	800	800	O	EL	..	..	154 7/16	62 5/16	91 5/16	18000
12-567B	P	2	12	8 1/16 x 10	1200	800	O	EL	..	..	174	64 7/8	91 5/16	24000
12-567B	P	2	12	8 1/16 x 10	1125	800	O	EL	..	..	174	64 7/8	91 5/16	23250
16-567B	P	2	16	8 1/16 x 10	1500	800	O	EL	..	..	212 11/16	62 9/16	91 5/16	29300

Engines are available for marine and industrial use through Cleveland Diesel Engine Division, G.M.C. All engines have open type combustion chambers.

Gray Marine Motor Company
687 Canton Avenue
Detroit 7, Michigan

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
D-157	M	4	4	3 3/16 x 4 1/8	30	1800	B	EL	..	T	47	22	26*	1100
D-260	M	4	4	3 7/8 x 5 1/2	50	1800	B	EL	..	T	52	22	31 1/2*	1400
D-572	M	4	6	4 3/4 x 5 3/8	135	2200	B	EL	..	T	78	27	28 3/4*	2700

*Engines have dyna-cell combustion systems. Marine use only. Horsepower ratings are maximum. *Height above prop. shaft center line.*

Hallett Manufacturing Co.
1601 W. Florence Ave.
Inglewood, Calif.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
AC1	S	4	1	3 1/2 x 3 5/8	5	1800	B	H-EL*	..	..	26 5/8	18	24	220
D-1A	S	4	1	3 7/8 x 4 3/4	8	1500	B-DM	H-EL*	..	..	24	20	30	450
D-2S	S	4	2	3 7/8 x 4 3/4	18	1500	B-DM	EL	..	..	31 5/8	23	31 3/4	566
D-1M	M	4	1	3 7/8 x 4 3/4	8	1500	B-DM	H-EL*	..	..	37 1/2	23	30	630
D-2MS	M	4	2	3 7/8 x 4 3/4	18	1500	B-DM	EL	..	..	49	23	31 3/4	760

*Engines have open combustion chamber. * Model designation refers to hand starting. "S" is added to designation to indicate electric starting.*

Harnischfeger Corporation, P & H Diesel Division
100 Lake Street
Port Washington, Wisconsin

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
187C	M-P	2	1	4 1/2 x 5 1/2	22	1400	BS-B-DM	EL	M	S-T-W	25 1/2	28 1/4	40 1/16	845-1180*
287C	M-P	2	2	4 1/2 x 5 1/2	44	1400	BS-B-DM	EL	M	S-T-W	32 1/2	28 1/4	40 1/16	1030-1350*
387C	M-P	2	3	4 1/2 x 5 1/2	66	1400	BS-B-DM	EL	M	S-T-W	38 7/8	28 1/4	40 1/16	1350-1775*
487C	M-P	2	4	4 1/2 x 5 1/2	88	1400	BS-B-DM	EL	M	S-T-W	45 3/8	28 1/4	40 1/16	1530-2175*
687C	M-P	2	6	4 1/2 x 5 1/2	132	1400	BS-B-DM	EL	M	S-T-W	59 1/8	28 1/4	40 1/16	1900-2950*

Weights shown are approximate for complete marine units including all accessories.

Hercules Motors Corp.
Canton, Ohio

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
DIXC	M-S-P	4	2	4 x 4 1/2	27.6	1800	B	EL	..	..	19 1/16	19 1/16	21	550
DIXD	M-S-P	4	2	4 1/4 x 4 1/2	30	1800	B	EL	..	..	19 1/16	19 1/4	21	550
DIX4B	M-S-P	4	4	3 1/4 x 4	40	2200	B	EL	..	..	26 7/8	21 11/16	19	550
DIX4D	M-S-P	4	4	3 1/2 x 4	48.5	2200	B	EL	..	..	26 7/8	21 11/16	19	550
DOOB	M-S-P	4	4	3 3/4 x 4 1/2	48	1800	B	EL	..	..	29 1/8	22 7/8	19 1/16	750
DOOC	M-S-P	4	4	4 x 4 1/2	55	1800	B	EL	..	..	29 1/8	22 7/8	19 3/4	750
DOOD	M-S-P	4	4	4 1/4 x 4 1/2	61.5	1800	B	EL	..	..	29 1/8	22 7/8	19 3/4	750
DIX6D	M-S-P	4	6	3 1/2 x 4	77.5	2200	B	EL	..	..	35 1/8	21 11/16	19	750
DJXB	M-S-P	4	6	3 1/2 x 4 1/2	60	1800	B	EL	..	..	36 1/4	20 5/8	20 1/16	950
DJXC	M-S-P	4	6	3 3/4 x 4 1/2	69	1800	B	EL	..	..	36 1/4	20 5/8	20 1/16	950
DJXH	M-S-P	4	6	3 3/4 x 4 1/2	79	1800	B	EL	..	..	36 1/4	20 5/8	21	950
DJXHP	M-S-P	4	6	3 3/4 x 4 1/2	79	1800	B	EL	..	..	38 3/8	34	13x10 3/16	950
DWXC	M-S-P	4	6	4 x 4 3/4	94	1800	B	EL	..	..	40 3/8	24	24	1350
DWXD	M-S-P	4	6	4 1/4 x 4 3/4	107	1800	B	EL	..	..	40 3/8	24	24	1350
DWXLD	M-S-P	4	6	4 1/4 x 5	112	1800	B	EL	..	..	40 3/8	24	24 1/16	1350
DWXLDP	M-S-P	4	6	4 1/4 x 5	106	1800	B	EL	..	..	37	36 1/16	8 3/4 x 9	1375
DRXB	M-S-P	4	6	4 3/4 x 5 1/4	103	1600	B	EL	..	..	44 1/16	25 1/2	24 7/8	1600
DRXC	M-S-P	4	6	4 3/4 x 5 3/4	118	1600	B	EL	..	..	44 3/8	25 1/2	24 7/8	1600
DPXB	M-S-P	4	6	5 x 6	160	1600	B	EL	..	..	55 1/2	29 1/4	30 1/2	2500
DPXC	M-S-P	4	6	5 1/4 x 6	176	1600	B	EL	..	..	55 1/2	29 1/4	30 1/2	2500
DPXD	M-S-P	4	6	5 1/2 x 6	191	1600	B	EL	..	..	55 1/2	29 1/4	30 1/2	2500
DPXE	M-S-P	4	6	5 3/4 x 6	199	1600	B	EL	..	..	55 1/2	29 1/4	30 1/2	2500
DPXH	M-S-P	4	6	5 3/4 x 6	220	1600	B	EL	..	..	55 1/2	29 1/4	31 1/16	2575
DPXHP	M-S-P	4	6	5 3/4 x 6	220	1600	B	EL	..	..	50 9/16	47 1/2	17 1/4 x 14 3/8	2575
DNX-V-8C	M-S-P	4	8	6 x 6	298	1600	B	EL	..	..	51 1/2	42	31 1/16	4200
DNX-V-8D	M-S-P	4	8	6 1/4 x 6	325	1600	B	EL	..	..	51 1/2	42	31 1/16	4200
DNX-V-8DS	M-S-P	4	8	6 1/4 x 6	405	1600	B	EL	M	..	51 1/2	42	31 1/16	4600

Engines have turbulence-chamber combustion system. All models suitable for marine, stationary or mobile use. Lengths are measured from bellhousing face to front support. Heights are measured from crankshaft to top of cylinder head cover. Weights are approximate and include engine with fuel handling equipment only and no other accessories not forming an integral part of the engine. Various mounting arrangements, flywheel housings, oil pans, manifolds, starting motor and generator locations are available to meet specific applications requirements.

Hill Diesel Engine Corporation
238 Mill Street
Lansing 3, Michigan

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
2R	M-S	4	2	3½ x 5½	9-17	800-1600	B	EL	..	S or T	50	32	47	1515
4R	M-S	4	4	3½ x 5½	18-34	800-1600	B	EL	..	S or T	60½	32	49	1865
6R	M-S	4	6	3½ x 5½	27-51	800-1600	B	EL	..	S or T	76½	32	49	2460

Engines have pre-combustion system. Dimensions and weights given are for marine models.

Ingersoll-Rand Co.
11 Broadway
New York 4, N. Y.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
T	M-S	4	6	7 x 8½	200	1000	O	A	..	..	86	48	69	9300
TS	M-S	4	6	7 x 8½	285	1000	O	A	M	..	86	48	69	9500
TS	M-S	4	8	7 x 8½	375	1000	O	A	M	..	108	48	69	12200
S	M-S	4	6	10½ x 12	450	720	O	A	..	..	132	40	85	21500
S	M-S	4	7	10½ x 12	525	720	O	A	..	..	149	40	85	24300
S	M-S	4	8	10½ x 12	600	720	O	A	..	..	165	40	85	27800
SS	M-S	4	6	10½ x 12	675	720	O	A	TC	..	132	40	85	23600
SS	M-S	4	7	10½ x 12	785	720	O	A	TC	..	149	40	85	27000
SS	M-S	4	8	10½ x 12	900	720	O	A	TC	..	165	40	85	30600

Engines have open type combustion chambers.

International Harvester Company
180 North Michigan Avenue
Chicago, Illinois

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
UD-6A	S-P	4	4	3¾ x 5¼	45	1600	O	G-EL	..	..	62⅛	26⅛	50¼	1765
UD-9A	S-P	4	4	4.4 x 5.5	62.5	1600	O	G-EL	..	..	67¾	28⅛	52	2060
UD-14A	S-P	4	4	4¾ x 6½	76	1400	O	G-EL	..	..	78	33½	56½	2650
UD-16	S-P	4	6	4.4 x 5.5	100	1800	O	G-EL	..	..	88⅛	33½	55⅛	3095
UD-18A	S-P	4	6	4¾ x 6½	125	1600	O	G-EL	..	..	95⅞	35⅞	59¾	4000
UD-24	S-P	4	6	5¾ x 7	180	1375	O	G-EL	..	..	107⅛	44	64	5700

Horsepower shown is net maximum with radiator and fan as obtained at sea level with regular production injection pump setting. Dimensions include radiator and direct drive rear power take-off.

Kahlenberg Brothers Company
Two Rivers, Wisconsin

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
AD	M	2	2	....	30- 36	375-400	O	A	..	†	..	..	..	4450
AT	M	2	3	....	45- 54	375-400	O	A	..	*	..	..	..	6500
BD	M	2	2	....	50- 60	340-375	O	A	..	†	..	..	..	7300
AF	M	2	4	....	70	375-400	O	A	..	*	..	..	..	8200
BT	M	2	3	....	90	340-375	O	A	..	*	..	..	..	9700
BF	M	2	4	....	120	340-375	O	A	..	*	..	..	..	11980
B5	M	2	5	....	150	340-375	O	A	..	*	..	..	..	15650
CT	M	2	3	....	150	275-325	O	A	..	*	..	..	..	21730
B6	M	2	6	....	180	340-375	O	A	..	*	..	..	..	17050
CF	M	2	4	....	200	275-325	O	A	..	*	..	..	..	23900
C5	M	2	5	....	250	275-325	O	A	..	D	..	..	..	29000
C6	M	2	6	....	300	275-325	O	A	..	D	..	..	..	34000

*All engines have pre-combustion chambers. † Reverse gear used. * Direct reverse. Reverse gear optional.*

Kermath Manufacturing Company
5890 Commonwealth Avenue
Detroit, Michigan

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
2-127	M	4	2	4¼ x 4½	27	1800	B	EL&H	..	S	37	25⅞	30⅝	900
4-226	M	4	4	4 x 4½	60	2600	B	EL	..	S	47⅞	24	33	1250
6-298	M	4	6	3¾ x 4½	75	2000	B	EL	..	S	54¾	25½	33	1550
6-529	M	4	6	4⅜ x 5¾	130	1800	B	EL	..	S	62⅜	27⅝	37¹⁵⁄₁₆	2450
6-935	M	4	6	5¾ x 6	250	2000	B	EL	..	C	88⅛	36⅜	50¼	5000

All engines have turbulence chamber type combustion system.

The Lathrop Engine Co.
Mystic, Conn.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. H.P.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
D50	M	4	4	5½ x 7	50	800	B	EL	..	O	75	29	31	3000
D60	M	4	4	5½ x 7	60	900	B	EL	..	O	75	29	31	3000
D80	M	4	6	5½ x 7	80	800	B	EL	..	S	96¼	30½	31	4200
D90	M	4	6	5½ x 7	90	900	B	EL	..	S	96¼	30½	31	4200
D100	M	4	6	5½ x 7	100	1000	B	EL	..	S	92½	30½	31	4000
DH-200	M	4	6	5¾ x 6	187	1600	B	EL	..	C	96	38¾	43¼	5100

Lister-Blackstone, Incorporated
Graybar Building, 420 Lexington Avenue
New York 17, N. Y.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
3/1	S	4	1	3¼ x 5½	3½	650	B	H	..	..	35½	24	40	750
5/1	S	4	1	4½ x 5½	6	650	B	H	..	..	35½	24	40	760
10/2	S	4	2	4½ x 5½	12	650	B	H	..	..	50	24	40	1130
CD	M-S	4	1	4½ x 4⅝	8	1200	B	H	..	O	40⅝	19	34½	980
CE	M-S	4	2	4½ x 4⅝	16	1200	B	H-EL	..	O	46⅜	23	36½	1380
9/1	M-S	4	1	4½ x 5½	9	1000	B	H	..	O	40½	25	40½	1175
18/2	M-S	4	2	4½ x 5½	21	1200	B	H-A-EL	..	O	47⅜	25	40½	1625
27/3	M-S	4	3	4½ x 5½	30	1200	B	H-A-EL	..	O	57½	25	40½	2040
38/4	M-S	4	4	4½ x 5½	40	1200	B	H-A-EL	..	O	66⅜	25	40½	2275
616	M-S	4	6	4½ x 5½	63	1200	B	A-EL	..	O	74½	32	43½	3000
EV2	M-S	4	2	8¾ x 11½	90	600	B	A	..	O	68⅜	48½	81⅝	9575
EV3	M-S	4	3	8¾ x 11½	135	600	B	A	..	O	81½	48½	81⅝	10375
EV4	M-S	4	4	8¾ x 11½	180	600	B	A	..	O	94⅜	48½	81⅝	10960
EV5	M-S	4	5	8¾ x 11½	225	600	B	A	..	O	111¼	48½	81⅝	14160
EV6	M-S	4	6	8¾ x 11½	270	600	B	A	..	D	124⅛	48½	81⅝	15660
EV8	M-S	4	8	8½ x 11½	360	600	B	A	..	D	149⅞	48½	81⅝	18860
EVS4	M-S	4	4	8¾ x 11½	240	600	B	A	TC	D	94⅜	48½	88	11260
EVS6	M-S	4	6	8¾ x 11½	360	600	B	A	TC	D	124⅛	48½	88	15960
EVS8	M-S	4	8	8¾ x 11½	480	600	B	A	TC	D	149⅞	48½	88	19360

EVS Engines are supercharged.

Marine models of all the above engines except the first three are available. The marine propulsion engines all have Lister-Blackstone type reverse gears, except the five largest which are direct reversing engines. Very heavy duty horizontal engines also are available, from 10 to 140 hp.; known as models JP, OP, RP, SP, TP, and TPT.

Mack-International Motor Truck Corp.
5th Avenue & 34th Street
New York, N. Y.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
ENDM605W‡	M	4	6	4⅜ x 6	100	1500	B	EL	..	T	80⅛	29	29¾	3400
END510*	P	4	6	4½ x 5½	138	2400	B	EL	..	..	49½	32½	45⅝	1991
END672*	P	4	6	4⅞ x 6	165	2000	B	EL	..	..	55⅛	31⅛	46⅝	2243
END672†	P	4	6	4⅞ x 6	165	2000	B	EL	..	..	49⅞	33	44⅛	2471

*"M" indicates marine use only. * Truck engine. † Bus engine. All models have energy cell combustion systems.*

Mechanical Equipment Company
861 Carondelet Corner St. Joseph Sts.
New Orleans 13, Louisiana

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
B6	M	4	6	3¾ x 4	79	2600	B	EL	..	S	51⅛	22	16¾	1050
D6	M	4	6	5¾ x 6	175	1900	B	EL-G-A	..	S	71⅛	24¼	29⅞	2950
E6	M	4	6	6¾ x 6½	202	1600	B	EL-G-A	..	S	94	26	37⅝	5100
G6	M	4	6	8½ x 8½	340	1050	B	EL-G-A	..	S	144⅞	32½	49¾	11950

Pre-combustion chambers are used on all engines. Horsepower ratings are maximum. Height above shaft is given.

Murphy Diesel Company
5317 West Burnham Street
Milwaukee, Wisconsin

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
ME4	P	4	4	5¾ x 6½	90	1280	O	EL	..	..	70	42⅝	65⅛	3800
ME46	P	4	4	6 x 6½	100	1200	O	EL	..	..	70	42⅝	65⅛	3800
11	P	4	4	5¾ x 6½	100	1200	O	EL	..	..	70	42⅝	65⅛	3800
12	P	4	4	6 x 6½	110	1200	O	EL	..	..	70	42⅝	65⅛	3800
111	P	4	4	5¾ x 6½	115	1200	O	EL	**	..	70	42⅝	65⅛	3900
112	P	4	4	6 x 6½	125	1200	O	EL	**	..	70	42⅝	65⅛	3900
20*	P	4	6	5½ x 6½	135	1200	O	EL	..	..	92½	42⅝	65⅛	4700
120	P	4	6	5½ x 6½	145	1200	O	EL	**	..	92½	42⅝	65⅛	4800
21*	P	4	6	5¾ x 6½	150	1200	O	EL	..	..	92½	42⅝	65⅛	4700
22*	P	4	6	6 x 6½	165	1200	O	EL	..	..	92½	42⅝	65⅛	4700
121	P	4	6	5¾ x 6½	170	1200	O	EL	**	..	92½	42⅝	65⅛	4800
122	P	4	6	6 x 6½	190	1200	O	EL	**	..	92½	42⅝	65⅛	4800
ME90	M	4	4	5¾ x 6½	90	1200	O	EL	..	T	91	39	63	6500
M100	M	4	4	5¾ x 6½	100	1200	O	EL	..	T	91	39	63	6650
M110	M	4	4	6 x 6½	110	1200	O	EL	..	T	91	39	63	6685
M115	M	4	4	5¾ x 6½	115	1200	O	EL	..	T	91	39	63	6830
M125	M	4	4	6 x 6½	125	1200	O	EL	..	T	91	39	63	6860
M135	M	4	6	5½ x 6½	135	1200	O	EL	..	S-T	115	38	61	7990
M145	M	4	6	5½ x 6½	145	1200	O	EL	**	S-T	115	38	55	8255
M150	M	4	6	5¾ 6½	150	1200	O	EL	..	S-T	115	38	61	8000
M165	M	4	6	6 x 6½	165	1200	O	EL	..	T	115	38	61	8000
M170	M	4	6	5¾ x 6½	170	1200	O	EL	**	T	115	38	55	8265
M190	M	4	6	6 x 6½	190	1200	O	EL	**	T	115	38	55	8265

*All engines have open type combustion chambers and unit injectors. * Stationary models available as dual-fuel and crude oil engine. **Turbo supercharging manifold.*

The National Supply Company
Engine Division, Mfgrs. of Superior and Atlas Engines
1401 Sheridan Ave., Springfield 99, Ohio
Superior Engines

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
40-S-6	S	4	6	8½ x 10½	175- 325	514- 900	B	A	..	..	..	..	..	13500
40-S-8	S	4	8	8½ x 10½	230- 435	514- 900	B	A	..	..	..	..	..	16500
40-SX-6	S	4	6	8½ x 10½	280- 510	514- 900	B	A	TC	..	..	..	..	14500
40-SX-8	S	4	8	8½ 10½	370- 675	514- 900	B	A	TC	..	..	..	..	17500

(Superior engine specifications continued on next page)

The National Supply Co. — Superior Engines

(Continued from the preceding page)

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
60-S-6	S	4	6	12 x 15	335- 530	327- 514	B	A	..	..	..	..	..	36000
60-S-8	S	4	8	12 x 15	450- 705	327- 514	B	A	..	..	..	..	..	43000
60-SX-6	S	4	6	12 x 15	505- 825	327- 514	B	A	TC	..	..	..	..	38000
60-SX-8	S	4	8	12 x 15	670-1100	327- 514	B	A	TC	..	..	..	..	45500
80-S-6	S	4	6	14½ x 20	555- 720	277- 360	BS	A	..	..	..	..	..	64000
80-S-8	S	4	8	14½ x 20	740- 960	277- 360	BS	A	..	..	..	..	..	79000
80-SX-6	S	4	6	14½ x 20	830-1125	277- 360	BS	A	TC	..	..	..	..	68000
80-SX-8	S	4	8	14½ x 20	1110-1500	277- 360	BS	A	TC	..	..	..	..	88000
40-M-6	M	4	6	8½ x 10½	170- 325	500- 900	B	A	..	D	..	..	..	14500
40-M-8	M	4	8	8½ x 10½	225- 435	500- 900	B	A	..	D	..	..	..	17000
40-MX-6	M	4	6	8½ x 10½	270- 490	500- 900	B	A	TC	D	..	..	..	15500
40-MX-8	M	4	8	8½ x 10½	360- 650	500- 900	B	A	TC	D	..	..	..	18000
60-M-6	M	4	6	12 x 15	335- 515	325- 500	B	A	..	D	..	..	..	38000
60-M-8	M	4	8	12 x 15	445- 685	325- 500	B	A	..	D	..	..	..	45000
60-MX-6	M	4	6	12 x 15	500- 770	325- 500	B	A	TC	D	..	..	..	40000
60-MX-8	M	4	8	12 x 15	670-1030	325- 500	B	A	TC	D	..	..	..	47500
80-M-6	M	4	6	14½ x 20	550- 720	275- 360	BS	A	..	D	..	..	..	68000
80-M-8	M	4	8	14½ x 20	735- 960	275- 360	BS	A	..	D	..	..	..	83000
80-MX-6	M	4	6	14½ x 20	825-1080	275- 360	BS	A	TC	D	..	..	..	72000
80-MX-8	M	4	8	14½ x 20	1100-1440	275- 360	BS	A	TC	D	..	..	..	90000

All engines have open type combustion chambers. Stationary weight includes standard flywheel extension shaft and outboard bearing. Marine weight includes flywheel and thrust bearing.

Atlas Engines

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
4ES327	P	4	4	7 x 8½	80	650	O	A	..	..	65	41	68¼	6000
6ES327	P	4	6	7 x 8½	120	650	O	A	..	..	89	42	69	9850
4HS528	S	4	4	8 x 10½	90	450	O	A	..	..	107	44	71	9700
4ES668	P	4	4	9 x 10½	155	600	O	A	..	..	82	52	72	12400
5ES668	P	4	5	9 x 10½	190	600	O	A	..	..	97	52	72	14870
6ES668	P	4	6	9 x 10½	230	600	O	A	..	..	113	52	76	16000
8ES668	P	4	8	9 x 10½	320	600	O	A	..	..	147	52	76	22000
4KS668	P	4	4	9 x 10½	155	600	B	A	..	..	107	55	69	13600
5KS668	P	4	5	9 x 10½	195	600	B	A	..	..	110	55	69	15800
6KS668	P	4	6	9 x 10½	278-290	720-750	B	A	..	..	126	55	69	17100
6KST668	P	4	6	9 x 10½	418-435	720-750	B	A	TC	..	141	55	80	18500
8KS668	P	4	8	9 x 10½	370-385	720-750	B	A	..	..	156	55	69	21600
8KST668	P	4	8	9 x 10½	567-580	720-750	B	A	TC	..	171	55	80	22800
4HS1558	S	4	4	11⅝ x 15	200	327	O	A	..	..	136	56	98	37000
6HS1558	S	4	6	11⅝ x 15	350	360	O	A	..	..	178	56	98	41000
6HS2124	S	4	6	13 x 16	425	327	O	A	..	..	204	67	102	41000
6HST2124	S	4	6	13 x 16	600	327	O	A	TC	..	204	67	102	53400
6ES2124	S	4	6	13 x 16	475	375	O	A	..	..	176	54	99	49000
	S	4	6	13 x 16	500	400	O	A	..	..	176	54	99	49000
6EST2124	S	4	6	13 x 16	700	375	O	A	TC	..	176	54	99	51600
	S	4	6	13 x 16	750	400	O	A	TC	..	176	54	99	51600
6HS3358	S	4	6	15 x 19	650	327	O	A	..	..	232	68	102	77000
6HST3358	S	4	6	15 x 19	1000	327	O	A	TC	..	232	68	102	80000
4EM-327	M	4	4	7 x 8½	80	650	O	A	..	S	110	41	66	8330
6EM-327	M	4	6	7 x 8½	120	650	O	A	..	S	134	42	61	10600
4HM-528	M	4	4	8 x 10½	85	450	O	A	..	O	136	43	68	11300
4HM-763	M	4	4	9 x 12	110	325	O	A	..	O	154	47	71	14760
4HM-1125	M	4	4	10½ x 13	155	350	O	A	..	O	163	51	81	17400
6HM-1125	M	4	6	10½ x 13	250	350	O	A	..	D	190	59	72	26750
6HM1558	M	4	6	11⅝ x 15	350	360	O	A	..	D	202	62	85	38900
6HM2124	M	4	6	13 x 16	425	325	O	A	..	D	230	75	87	46670
6HMT2124	M	4	6	13 x 16	600	325	O	A	TC	D	230	75	87	49670
6HM3358	M	4	6	15 x 19	650	325	O	A	..	D	268	89	98	76000
6HMT3358	M	4	6	15 x 19	1000	325	O	A	TC	D	268	89	98	79000
4KM668RG	M	4	4	9 x 10½	150	600	BS	A	..	W-D	147	55	74	16500
5KM668RG	M	4	5	9 x 10½	185	600	BS	A	..	W-D	163	55	74	18000
6KM668RG	M	4	6	9 x 10½	275	750	BS	A	..	W-D	178	55	74	21000
6KMT668RG	M	4	6	9 x 10½	415	750	BS	A	TC	W-D	178	55	83	22000
6KMT668DR	M	4	6	9 x 10½	425	750	BS	A	TC	W-D	158	55	83	21000
8KM668RG	M	4	8	9 x 10½	365	750	BS	A	..	W-D	208	55	83	25500
8KM668DR	M	4	8	9 x 10½	375	750	BS	A	..	W-D	188	55	74	24500
8KMT668RG	M	4	8	9 x 10½	550	750	BS	A	TC	W-D	208	55	74	26700
8KMT668DR	M	4	8	9 x 10½	570	750	BS	A	TC	W-D	188	55	83	25700

Nordberg Manufacturing Company
Milwaukee, Wisconsin

Mode	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
4FS-1	S	4	1	4x x 5¼	10- 15	1200-1800	..	EL-H	..	..	..	..	..	....
4FS-2	S	4	2	4½ x 5¼	20- 30	1200-1800	..	EL-H	..	..	..	..	..	....
FS-94	S	4	4	9 x 11½	150- 210	514- 720	..	A	..	..	..	..	..	....
FS-95	S	4	5	9 x 11½	185- 265	514- 720	..	A	..	..	..	..	..	....
FS-96	S	4	6	9 x 11½	225- 320	514- 720	..	A	..	..	..	..	..	....
FS-97	S	4	7	9 x 11½	265- 370	514- 720	..	A	..	..	..	..	..	....
FS-98	S	4	8	9 x 11½	305- 425	514- 720	..	A	..	..	..	..	..	....
FS-94-SC	S	4	4	9 x 11½	265- 320	600- 720	..	A	TC	..	..	..	..	....
FS-95-SC	S	4	5	9 x 11½	280- 400	514- 720	..	A	TC	..	..	..	..	....
FS-96-SC*	S	4	6	9 x 11½	340- 480	514- 720	..	A	TC	..	..	..	..	....
FS-97-SC*	S	4	7	9 x 11½	400- 455	514- 720	..	A	TC	..	..	..	..	....
FS-98-SC*	S	4	8	9 x 11½	455- 635	514- 720	..	A	TC	..	..	..	..	....
FS-135	S	4	5	13 x 16½	445- 570	400- 514	..	A	..	..	..	..	..	....
FS-136	S	4	6	13 x 16½	535- 685	400- 514	..	A	..	..	..	..	..	....
FS-137	S	4	7	13 x 16½	620- 800	400- 514	..	A	..	..	..	..	..	....
FS-138	S	4	8	13 x 16½	710- 915	400- 514	..	A	..	..	..	..	..	....
FS-135-SC	S	4	5	13 x 16½	665- 850	400- 514	..	A	TC	..	..	..	..	....
FS-136-SC*	S	4	6	13 x 16½	800-1030	400- 514	..	A	TC	..	..	..	..	....
FS-137-SC*	S	4	7	13 x 16½	935-1200	400- 514	..	A	TC	..	..	..	..	....
FS-138-SC*	S	4	8	13 x 16½	1070-1370	400- 514	..	A	TC	..	..	..	..	....
FS-165	S	4	5	16 x 22	730	327	..	A	..	..	..	..	..	....
FS-166	S	4	6	16 x 22	875	327	..	A	..	..	..	..	..	....
FS-167	S	4	7	16 x 22	1020	327	..	A	..	..	..	..	..	....
FS-168	S	4	8	16 x 22	1165	327	..	A	..	..	..	..	..	....

(Nordberg engine specifications continued on next page)

Nordberg Manufacturing Company

(Continued from preceding page)

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
FS-165-SC	S	4	5	16 x 22	1090	327	..	A	TC	..	..	..	..	..
FS-166-SC*	S	4	6	16 x 22	1310	327	..	A	TC	..	..	..	..	..
FS-167-SC*	S	4	7	16 x 22	1530	327	..	A	TC	..	..	..	..	..
FS-168-SC*	S	4	8	16 x 22	1750	327	..	A	TC	..	..	..	..	..
5DB-24	S	4	5	16½ x 24	795	300	..	A	..	..	..	..	..	..
6DB-24	S	4	6	16½ x 24	955	300	..	A	..	..	..	..	..	..
7DB-24	S	4	7	16½ x 24	1115	300	..	A	..	..	..	..	..	..
8DB-24	S	4	8	16½ x 24	1270	300	..	A	..	..	..	..	..	..
5DBT-24	S	4	5	16½ x 24	1190	300	..	A	TC	..	..	..	..	..
6DBT-24	S	4	6	16½ x 24	1430	300	..	A	TC	..	..	..	..	..
7DBT-24	S	4	7	16½ x 24	1670	300	..	A	TC	..	..	..	..	..
8DBT-24	S	4	8	16½ x 24	1900	300	..	A	TC	..	..	..	..	..
RTS-1411	S	2	11	14 x 16	1650	400	..	A	..	..	..	..	..	..
TS-173	S	2	3	17½ x 25	880	277	..	A	..	..	..	..	..	..
TS-174	S	2	4	17½ x 25	1175	277	..	A	..	..	..	..	..	..
TS-175	S	2	5	17½ x 25	1470	277	..	A	..	..	..	..	..	..
TS-176	S	2	6	17½ x 25	1765	277	..	A	..	..	..	..	..	..
TS-177	S	2	7	17½ x 25	2060	277	..	A	..	..	..	..	..	..
TS-178	S	2	8	17½ x 25	2350	277	..	A	..	..	..	..	..	..
TS-179	S	2	9	17½ x 25	2650	277	..	A	..	..	..	..	..	..
TS-215	S	2	5	21½ x 29	2300	225	..	A	..	..	..	..	..	..
TS-216	S	2	6	21½ x 29	2750	225	..	A	..	..	..	..	..	..
TS-217	S	2	7	21½ x 29	3225	225	..	A	..	..	..	..	..	..
TS-218	S	2	8	21½ x 29	3675	225	..	A	..	..	..	..	..	..
TS-219	S	2	9	21½ x 29	4150	225	..	A	..	..	..	..	..	..
TS-2110	S	2	10	21½ x 29	4600	225	..	A	..	..	..	..	..	..
TS-2111	S	2	11	21½ x 29	5060	225	..	A	..	..	..	..	..	..
TS-2112	S	2	12	21½ x 29	5500	225	..	A	..	..	..	..	..	..
TS-295	S	2	5	29 x 40	4000	171	..	A	..	..	..	..	..	..
TS-296	S	2	6	29 x 40	4800	171	..	A	..	..	..	..	..	..
TS-297	S	2	7	29 x 40	5600	171	..	A	..	..	..	..	..	..
TS-298	S	2	8	29 x 40	6400	171	..	A	..	..	..	..	..	..
TS-299	S	2	9	29 x 40	7200	171	..	A	..	..	..	..	..	..
TS-2910	S	2	10	29 x 40	8000	171	..	A	..	..	..	..	..	..
TS-2911	S	2	11	29 x 40	8800	171	..	A	..	..	..	..	..	..
TS-2912	S	2	12	29 x 40	9600	171	..	A	..	..	..	..	..	..

These engines are designed to operate continuously at the ratings shown and are good for 10 per cent overload for 2 hours in any 24 hour period.
** Ratings shown can be increased with high pressure supercharging and intercooling.*

Osco Motors Corporation
3627 W. Lawrence Street
Philadelphia, Pennsylvania

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
235D	M-S	4	2	4 x 4½	28	1800	B	EL	..	P	38	27 5/16	36 5/16	850†-1027*
235X	M-S	4	2	4 x 4½	28	1800	B	EL	..	P	45 5/16	27 5/16	36 5/16	910†-1075*
235Z	M-S	4	2	4 x 4½	28	1800	B	EL	..	P	45 5/16	27 5/16	36 5/16	925†-1088*
470D	M-S	4	4	4 x 4½	70	2600	B	EL	..	P	45 5/16	22	35 5/16	1200†-1385*
470TD-2	M-S	4	4	4 x 4½	70	2600	B	EL	..	T	49 5/16	22	35 5/16	1260†-1417*
470TD-3	M-S	4	4	4 x 4½	70	2600	B	EL	..	T	49 5/16	22	35 5/16	1275†-1430*
685D	M-S	4	6	3¾ x 4½	85	2600	B	EL	..	P	52 5/16	22	37 5/16	1365†-1423*
685TD-2	M-S	4	6	3¾ x 4½	85	2600	B	EL	..	T	60 5/16	22	37 5/16	1430†-1513*
685TD-3	M-S	4	6	3¾ x 4½	85	2600	B	EL	..	T	60 5/16	22	37 5/16	1450†-1526*

** Marine weight. † Stationary weight.*

Page Engineering Company
Clearing Post Office
Chicago 38, Illinois

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
9 3/16 x 12 1/16	P	4	3	9 3/16 x 12 1/16	135	500	BS	A	..	..	72	84	42	12750
11 x 15	P	4	3	11 x 15	195	450	BS	A	..	..	82	99	51	16750
11 x 15	P	4	4	11 x 15	260	450	BS	A	..	..	104 1/16	99	51	22330
11 x 15	P	4	5	11 x 15	325	450	BS	A	..	..	122	99	51	27750
12 1/16 x 16	P	4	3	12 1/16 x 16	270	450	BS	A	..	..	90 1/16	110 1/16	55	21750
12 1/16 x 16	P	4	4	12 1/16 x 16	350	450	BS	A	..	..	114	110 1/16	55	29330
12 1/16 x 16	P	4	5	12 1/16 x 16	450	450	BS	A	..	..	132 1/16	110 1/16	55	36200
12 1/16 x 16	P	4	6	12 1/16 x 16	540	450	BS	A	..	..	156	110 1/16	55	43500

All engines are of the horizontal type and are designed especially for dragline excavator service.

Palmer Brothers Engine Corporation
Cos Cob, Connecticut

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
RND-1	S	4	1	4 5/16 x 6	9	1000	B	H	..	..	31 1/16	25	41	900
RND-4	M-S	4	4	4 5/16 x 6	40	1200	B	EL-H	..	O	72	26 5/16	42	2500
RND-6	M-S	4	6	4 5/16 x 6	60	1200	B	EL-H	..	O	88 1/16	24 1/16	45	3200
RND-4G2	M-S	4	4	4 5/16 x 6	40	1200	B	EL-H	..	O	80	26 5/16	42	2590
RND-6G2	M-S	4	6	4 5/16 x 6	60	1200	B	EL-H	..	O	95 1/16	24 1/16	45	3300

Engines have Russell-Newbury turbulence chamber.

Rathbun-Jones Engineering Company
Toledo, Ohio

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
18	S	4	3	11 x 18	220	450	O	A	..	..	158	70	106	26000
18	S	4	4	11 x 18	290	450	O	A	..	..	177	70	106	31500
18	S	4	5	11 x 18	364	450	O	A	..	..	196	70	106	36300
18	M-S	4	6	11 x 18	435	450	O	A	..	D	215	70	106	37600*-41200†
18	M-S	4	7	11 x 18	510	450	O	A	..	D	238	70	106	41900*-46000†
18	M-S	4	8	11 x 18	580	450	O	A	..	D	258	70	106	46500*-51000†

(Rathbun-Jones engine specifications continued on the next page)

Rathbun-Jones Engineering Company

(Continued from preceding page)

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
22	S	4	3	15½ x 22	388	327	O	A	..	..	175	80	126	41500
22	S	4	4	15½ x 22	518	327	O	A	..	..	197	80	126	50000
22	S	4	5	15½ x 22	650	327	O	A	..	..	225	80	126	58500
22	M-S	4	6	15½ x 22	775	327	O	A	..	D	247	80	126	64000*–68000†
22	M-S	4	7	15½ x 22	910	327	O	A	..	D	271	80	126	71000*–76500†
22	M-S	4	8	15½ x 22	1035	327	O	A	..	D	293	80	126	82000*–85000†
24	S	4	3	18¼ x 24	540	300	O	A	..	..	200	85	140	60000
24	S	4	4	18¼ x 24	720	300	O	A	..	..	231	85	140	74000
24	S	4	5	18¼ x 24	900	300	O	A	..	..	258	85	140	87000
24	M-S	4	6	18¼ x 24	1080	300	O	A	..	D	294	85	140	90000*–98000†
24	M-S	4	7	18¼ x 24	1260	300	O	A	..	D	321	85	140	103000*–110000†
24	M-S	4	8	18¼ x 24	1440	300	O	A	..	D	348	85	140	116000*–120000†
28	S	4	5	19½ x 28	1025	257	O	A	..	..	332	104	171	140000
28	M-S	4	6	19½ x 28	1230	257	O	A	..	D	339	104	171	160000*–164000†
28	M-S	4	7	19½ x 28	1435	257	O	A	..	D	380	104	171	184000*–187000†
28	M-S	4	8	19½ x 28	1640	257	O	A	..	D	409	104	171	209000*–212000†
28	S	4	10	19½ x 28	2050	257	O	A	..	..	460	104	171	230000
28	S	4	12	19½ x 28	2460	257	O	A	..	..	528	104	171	260000

*Engines have Price turbulence chamber combustion system and Rathbun distributor type fuel injection system. Lengths listed are approximate for stationary engines and include generator, exciter drive and outboard bearing. Widths include operating platforms. Marine lengths including thrust bearing are considerably shorter. All engines can be furnished for dual-fuel operation. * Marine weight. † Stationary weight.*

Red Wing Motor Company
Red Wing, Minnesota

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
H4-54	M	4	4	4 x 5	42– 54	1500	B	EL	..	P	49	17½	32	1000
H4-60	M	4	4	5⅛ x 5½	55– 60	1400	B	EL	..	P	53	17½	34	1200
H6-140	M	4	6	4½ x 5½	100– 140	1500	B	EL	..	S	72	24½	40	2000
D4-30	M	4	4	3⅛ x 3¾	30	1800	B	EL	..	S	43	24½	29½	1825
D-65	M	4	4	4⅛ x 4½	65	1900	B	EL	..	P	57	23½	35	1400
D6-160	M	4	6	5⅛ x 6	160	1400	B	EL	..	S	75	27	34	3000
D6-200	M	4	6	6¼ x 6½	200	1300	B	EL	..	S	86	36	36	5000

"H" models are Waukesha-Hesselman units adapted for marine use. "D" model is full compression ignition diesel engine.

Regal Marine Engine Company
Coldwater, Michigan

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
DBH	M	4	2	6 x 8	28	400– 800	B	EL	..	..	....	....	....	....
DF	M	4	6	3¾ x 4½	84	2600	B	EL	..	..	53¾	18½	24¾	1360

R. H. Sheppard Company, Incorporated
Hanover, Pennsylvania

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
14*	S¶	4	1	3 x 4	3¾	1800	O	H-EL	..	..	22½	20¾	28½	400
14C*	M	4	1	3 x 4	3¾	1800	O	H-EL	..	P	37	21½	29⅝	390
8	S	4	1	3 x 4	3¾	1800	O	H-EL	..	..	22½	20¾	28½	400
7	S	4	1	4 x 5	8	1200	O	H-EL	..	..	37	30¾	49½	1000
7D	S	4	1	4¼ x 5	9	1200	O	H-EL	..	..	37	30¾	49½	1000
7C	M	4	1	4 x 5	8	1200	O	H-EL	..	S	37⅞	23½	41¾	1085
7F	M	4	1	4¼ x 5	9	1200	O	H-EL	..	..	37⅞	23½	41¾	1085
13	S	4	2	4 x 5	18	1400	O	H-EL	..	..	42⅝	19¼	45	1355
13D	S	4	2	4¼ x 5	21	1400	O	H-EL	..	..	42⅝	19¼	45	1355
13C	M	4	2	4 x 5	20	1800	O	H-EL	..	S	44	23½	37¾	1450
13F	M	4	2	4¼ x 5	22	1800	O	H-EL	..	S	44	23½	37¾	1450
6	S	4	3	4 x 5	28	1400	O	H-EL	..	..	53⅞	25	46½	1660
6D	S	4	3	4¼ x 5	31	1400	O	H-EL	..	..	53⅞	25	46½	1660
6C	M	4	3	4 x 5	30	1800	O	H-EL	..	S	51⅞	23½	37¾	1865
6F	M	4	3	4¼ x 5	34	1800	O	H-EL	..	S	51⅞	23½	37¾	1865
12	S	4	6	4 x 5	56	1400	O	EL	..	..	69½	24	49¾	2300
12D	S	4	6	4¼ x 5	62	1400	O	EL	..	..	69½	24	49¾	2300
12C	M	4	6	4 x 5	61	1800	O	EL	..	S	71	24½	40¾	2510
12F	M	4	6	4¼ x 5	67	1800	O	EL	..	S	71	24½	40¾	2510

*All engines have pre-combustion type chambers. * Air cooled.*

Sterling Engine Company
Buffalo, New York

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb
1AB-6	S	4	6	4½ x 5¾	72– 110	1400–1800	B	EL	..	..	57⅛	30	52⅝	3150
MAB-6	M	4	6	4½ x 5¾	72– 110	1400–1800	B	EL	..	S	66⅛	33¼	38⅞	2650
MRAB-6	M	4	6	4½ x 5¾	72– 110	1400–1800	B	EL	..	S	75⅛	33¼	38⅞	2800
1DB-6	S	4	6	5½ x 7	114– 170	1200–1500	B	EL	..	..	59⅛	36	59⅛	5200
MDB-6	M	4	6	5½ x 7	114– 170	1200–1500	B	EL	..	S	87⅛	39⅛	49⅝	4700
MRDB-6	M	4	6	5½ x 7	114– 170	1200–1500	B	EL	..	S	97⅛	39⅛	49⅝	5000
1DB-8	S	4	8	5½ x 7	152– 230	1200–1500	B	EL	..	..	74⅞	36	59⅛	6850
MDB-8	M	4	8	5½ x 7	152– 230	1200–1500	B	EL	..	S	103⅛	39⅛	49⅝	5850
MRDB-8	M	4	8	5½ x 7	152– 230	1200–1500	B	EL	..	S	120⅛	39⅛	49⅝	6400
VDS-6	S	4	6	8 x 9	270– 325	1000–1200	BS	EL-A	..	..	95	39¼	63¼	8500
VDM-6	M	4	6	8 x 9	270– 325	1000–1200	BS	EL-A	..	S-T	136⅜*	40½	67½	12000
VDS-6-S	S	4	6	8 x 9	520– 660	1000–1200	B	EL-A	TC	..	114¼	39¼	63¼	9160
VDM-6-S	M	4	6	8 x 9	520– 600	1000–1200	B	EL-A	TC	S	141	40½	70¼	13600
VDS-8-S	S	4	8	8 x 9	700– 880	1000–1200	B	EL-A	TC	..	134⅝	39¼	64	12450

*All engines have open type combustion chambers. Dual listings indicate continuous and intermittent ratings. *Snow-Nabstedt; for Twin Disc—add 9⅛ in.*

Sun Shipbuilding and Dry Dock Co.
Chester, Pennsylvania

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
510-LB-3	M	2	3	20¼ x 44½ +33⅛	1500	90	O	A	..	D	444	132	336	322000
540-L-4	M	2	4	21¾ x 42½ +42½	2500	90	O	A	..	D	576	132	361¾*	470000
580-L-4	M	2	4	22⅝ x 45⅝ +45⅝	2800	80	O	A	..	D	612	134	389	580000
600-L-4	M	2	4	23⅝ x 45⅝ +45⅝	3000	80	O	A	..	D	624	134	389	625000
600-LB-4	M	2	4	23⅝ x 45⅝ +33⅞	2700	100	O	A	..	D	624	134	384¼*	600000
640-LB-6	M	2	6	25⅛ x 45⅝ +33⅛	5600	100	O	A	..	D	816	134	426½*	930000
26-LB-4	M	2	4	26 x 46 +33	3600	115	O	A	..	D	623¾	134	400¾*	655000
31-LB-4	M	2	4	31 x 50 +36	4800	90	O	A	..	D	729	152	432⅞*	1015000
31-LB-5	M	2	5	31 x 50 +36	7200	100	O	A	..	D	807¾	152	406½	1166000
32-LB-4	M	2	4	32 x 55 +40	6000	94	O	A	..	D	735⅝	152	427	1052000
32-LB-5	M	2	5	32 x 55 +40	7500	94	O	A	..	D	861¹¹⁄₁₆	152	489¼*	1342000
21-LB-6†	M	2	6	21 x 35 +25	4500	180	O	A	..	D	601⅞	126¼	292	450000
...	S	2	4	21 x 35 +25	3000	200	..	..	..	..	539¼	126¼	315*	366000
...	S	2	5	21 x 35 +25	3800	200	..	..	..	..	628½	126¼	325*	458000
...	S	2	6	21 x 35 +25	4500	200	..	..	..	..	718	126¼	333*	550000
...	S	2	4	26 x 46 +33	4500	150	..	..	..	..	623¾	134	400¾*	655000
...	S	2	5	26 x 46 +33	6000	150	..	..	..	..	756¾	134	399*	820000
...	S	2	6	26 x 46 +33	7500	150	..	..	..	..	862½	134	411*	985000
...	S	2	4	32 x 55 +40	9000	138	..	..	..	..	735¾	152	467¼*	1145000
...	S	2	5	32 x 55 +40	11200	138	..	..	..	..	861¾	152	489¼*	1342000
...	S	2	6	32 x 55 +40	13500	138	..	..	..	..	1092	152	443¼*	1700000

*Engines are of the opposed-piston type. † Drives through reduction gear (Ratio 2.092 to 1) Maximum heights shown. * Height to top of scavenging air pump. Other figures show cylinder height.*

Union Diesel Engine Co.
Oakland, Calif.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Heigth In.	Weight Lb.
GA6	S-M	4	6	8½ x 11	175- 225	450- 600	O	A	..	D	144	34	72	14000
GA6S	S-M	4	6	8½ x 11	260- 330	450- 600	O	A	TC	D	146	34	72	15000
L6	S-M	4	6	10 x 14	230- 340	350- 514	O	A	..	D	175	42	85	23500
L6S	S-M	4	6	10 x 14	340- 500	350- 514	O	A	TC	D	178	42	85	24500
P6	S-M	4	6	12 x 15	410- 525	400- 514	O	A	..	D	194	46	93	36500
P6S	S-M	4	6	12 x 15	600- 775	400- 514	O	A	TC	D	194	46	93	38000
V6	S-M	4	6	14 x 19	560- 690	325- 400	O	A	..	D	242	57	114	58000
V6S	S-M	4	6	14 x 19	740-1020	325- 400	O	A	TC	D	242	57	114	60000
Z6	S-M	4	6	16 x 20½	600- 750	240- 300	O	A	..	D	275	62	125	87500
Z6S	S-M	4	6	16 x 20½	900-1125	240- 300	O	A	TC	D	285	62	125	90000
GA8	S-M	4	8	8½ x 11	235- 300	450- 600	O	A	..	D	178	34	72	18000
GA8S	S-M	4	8	8½ x 11	345- 440	450- 600	O	A	TC	D	180	34	72	19000
L8	S-M	4	8	10 x 14	300- 450	350- 514	O	A	..	D	214	42	85	32000
L8S	S-M	4	8	10 x 14	420- 660	350- 514	O	A	TC	D	217	42	85	33500
P8	S-M	4	8	12 x 15	550- 700	400- 514	O	A	..	D	235	46	93	46000
P8S	S-M	4	8	12 x 15	800-1040	400- 514	O	A	TC	D	239	46	93	48000
V8	S-M	4	8	14 x 19	750- 925	325- 400	O	A	..	D	292	57	114	74000
V8S	S-M	4	8	14 x 19	1125-1400	325- 400	O	A	TC	D	296	57	114	76000
Z8	S-M	4	8	16 x 20½	800-1000	240- 300	O	A	..	D	347	62	125	112000
Z8S	S-M	4	8	16 x 20½	1200-1500	240- 300	O	A	TC	D	350	62	125	115000

All engines are 4-cycle, single-acting, vertical, and use the patented, solid injection type UNION fuel system. Starting is by air at approximately 250 p.s.i. pressure. Supercharging is by Buch v turbocharger system.

United States Motors Corporation
Oshkosh, Wisconsin

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. H.P.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Heigth In.	Weight Lb.
2FMB12	M-S	4	1	3½ x 4	3.75	1200	O	H-EL	..	..	37	22	31	675
3FMB18	M-S	4	1	3½ x 4	5.25	1800	O	H-EL	..	..	37	22	31	675
5AT12	M-S	4	3	3½ x 3¾	11.8	1200	B	EL	..	..	50	33	45	1050
5AT18	S	4	3	3½ x 3¾	17	1800	B	EL	..	..	50	33	45	1050
705AT18	M-S	4	3	3½ x 3¾	17	1800	B	EL	..	..	52	33	45	1400
5DAC12	M-S	4	4	3⅝ x 3¾	20	1200	B	EL	..	..	55	26	43	1500
5DAC14	M	4	4	3⅝ x 3¾	22	1400	B	EL	..	..	55	26	43	1500
5DAC18	S	4	4	3⅝ x 3¾	30	1800	B	EL	..	..	55	26	43	1500
705DAC12	M-S	4	4	3⅝ x 3¾	20	1200	B	EL	..	..	59	26	43	1550
704D4D12	M-S	4	4	3¾ x 4	26	1200	B	EL	..	..	62	23	43	1600
705DAC14	M	4	4	3⅝ x 3¾	22	1400	B	EL	..	..	59	26	43	1550
705DAC18	M-S	4	4	3⅝ x 3¾	30	1800	B	EL	..	..	59	26	43	1550
10DAC12	M-S	4	4	3⅝ x 3¾	20	1200	B	EL	..	..	60	26	43	1650
10D4D12	M-S	4	4	3¾ x 4	26	1200	B	EL	..	..	65	26	43	1700
10DAC14	M	4	4	3⅝ x 3¾	22	1400	B	EL	..	..	60	26	43	....
10DAC18	M-S	4	4	3⅝ x 3¾	30	1800	B	EL	..	..	60	26	43	....
10D4D18	M-S	4	4	3¾ x 4	41.5	1800	B	EL	..	..	65	25	43	1700
15DC12	M-S	4	4	4 x 4½	42	1200	B	EL	..	..	70	25	47	....
15DAC18	M-S	4	4	3⅝ x 3¾	30	1800	B	EL	..	..	60	26	43	....
15D4D18	M-S	4	4	3¾ x 4	46.5	1800	B	EL	..	..	67	25	43	1800
20DJC12	M-S	4	6	3¾ x 4½	47	1200	B	EL	..	..	76	25	43	2400
20D4D18	M-S	4	4	3¾ x 4	41.5	1800	B	EL	..	..	69	25	43	2000
25DJH12	M-S	4	6	3¾ x 4½	52	1200	B	EL	..	..	88	28	48	2900
25DC18	S	4	4	4 x 4½	55.8	1800	B	EL	..	..	70	25	47	2500
30DWD12	M-S	4	6	4¼ x 4¾	70	1200	B	EL	..	..	93	31	52	3700
30DJC18	S	4	6	3¾ x 4½	69.8	1800	B	EL	..	..	76	25	43	2400
40DRC12	M-S	4	6	4⅝ x 5¼	90	1200	B	EL	..	..	98	34	53	4800
40DJH18*	S	4	6	3¾ x 4½	79.8	1800	B	EL	..	..	90	29	48	3500
50DFB12	M-S	4	6	5 x 6	121	1200	B	EL	..	..	110	37	77	6200
50DWD18*	S	4	6	4¼ x 4¾	107.5	1800	B	EL	..	..	93	31	52	4100
60DFC12	M-S	4	6	5¼ x 6	134	1200	B	EL	..	..	112	37	77	6300
60DRC18*	S	4	6	4⅝ x 5¼	130	1800	B	EL	..	..	98	34	53	4800
75DFE12	M-S	4	6	5⅝ x 6	156	1200	B	EL	..	..	113	33	77	6400
100WKD12	M-S	4	6	6¼ x 6½	189	1200	B	EL	..	..	118	44	79	9000
100DFD18*	S	4	6	5½ x 6	204	1800	B	EL	..	..	112	37	77	6700
125DV12	M-S	4	8	6¼ x 6	252	1200	B	EL	..	..	114	44	76	11000
140DV12*	S	4	8	6¼ x 6	252	1200	B	EL	..	..	117	44	76	11000
200DV18*	S	4	8	6¼ x 6	359	1800	B	EL	..	..	120	44	76	11500

*Marine and stationary engine-generator sets. * For emergency or stand-by use only. FMB Models—Fairbanks-Morse engine; AT Models—Atlas engine; DAC and WKD Models—Waukesha engine; All Others—Hercules engine.*

Venn-Severin Machine Co.
1317-31 W. North Avenue
Chicago, Ill.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. H.P.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
HCL-1	M-S-P	2	1	7 x 8	20	650	B	A-EL	M	S-T	34	35	54	2300
HCL-2	M-S-P	2	2	7 x 8	40– 50	650– 750	B	A-EL	M	S-T	47	35	54	3500
HCL-3	M-S-P	2	3	7 x 8	60– 75	650– 750	B	A-EL	M	S-T	58	35	54	4500
HCV-4	M-S-P	2	4	7 x 8	100– 120	750– 900	B	A-EL	M	S-T	55	50	76	5500
HCV-6	M-S-P	2	6	7 x 8	150– 180	750– 900	B	A-EL	M	S-T	68	50	76	6100
HCV-8	M-S-P	2	8	7 x 8	200– 240	750– 900	B	A-EL	M	S-T	80	50	78	7100
HCV-10	M-S-P	2	10	7 x 8	250– 300	750– 900	B	A-EL	M	S-T	93	50	78	8100
DMI-1	S	2	1	12¼ x 13½	40	327	O	A	..	..	59	54	92	8100
DMK-1	S	2	1	14¼ x 16½	60	327	O	A	..	..	70	60	110	12500
DMI-2	S	2	2	12¼ x 13½	100	327	O	A	..	..	85	54	92	14000
DMK-2	S	2	2	14¼ x 16½	140	327	O	A	..	..	98	60	110	21000
DMK-3	S	2	3	14¼ x 16½	215	327	O	A	..	..	121	60	110	27000
DMK-4	S	2	4	14¼ x 16½	300	327	O	A	..	..	147	50	110	32000

HCL and HCV engines have open combustion chambers.

Washington Iron Works
1500 Sixth Avenue, South
Seattle, Washington

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. H.P.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
3-125	M-S	4	3	9 x 12½	90	400	BS	A	..	O	128	37½	82½	13500
4-125	M-S	4	4	9 x 12½	120	400	BS	A	..	O	142	37½	82½	14700
5-125	M-S	4	5	9 x 12½	150	400	BS	A	..	D	137	37½	82½	16500
6-125	M-S	4	6	9 x 12½	200	450	BS	A	..	D	151	37½	82½	18000
6-125TS	M-S	4	6	9 x 12½	285	450	BS	A	TC	D	151	37½	82½	19000
8-125	M-S	4	8	9 x 12½	270	450	BS	A	..	D	181	37½	82½	21000
8-125TS	M-S	4	8	9 x 12½	380	450	BS	A	TC	D	181	37½	82½	22000
3-13	M-S	4	3	10¼ x 13½	120	360	BS	A	..	O	136	40	89	15800
4-13	M-S	4	4	10¼ x 13½	160	360	BS	A	..	O	158	40	89	18500
6-13	M-S	4	6	10¼ x 13½	260	390	BS	A	..	D	166	40	89	23000
6-13TS	M-S	4	6	10¼ x 13½	345	390	BS	A	TC	D	166	40	89	24000
8-13	M-S	4	8	10¼ x 13½	350	390	BS	A	..	D	202	40	89	26500
8-13TS	M-S	4	8	10¼ x 13½	460	390	BS	A	TC	D	202	40	89	27500
4-15	M-S	4	4	11½ x 15	200	327	BS	A	..	D	169	46	100	27000
6-15	M-S	4	6	11½ x 15	330	360	BS	A	..	D	189	46	100	31500
6-15TS	M-S	4	6	11½ x 15	450	360	BS	A	TC	D	189	46	100	33000
8-15	M-S	4	8	11½ x 15	440	360	BS	A	..	D	233	46	100	40500
8-15TS	M-S	4	8	11½ x 15	600	360	BS	A	TC	D	233	46	100	43000
6-160	M-S	4	6	12¾ x 16	400	360	BS	A	..	D	209	50	106½	42000
6-160TS	M-S	4	6	12¾ x 16	585	360	BS	A	TC	D	209	50	106½	44000
8-160	M-S	4	8	12¾ x 16	550	360	BS	A	..	D	249	50	106½	53000
8-160TS	M-S	4	8	12¾ x 16	780	360	BS	A	TC	D	294	50	106½	55000
6-18	M-S	4	6	14½ x 18	500	300	BS	A	..	D	245	56	120½	62500
6-18TS	M-S	4	6	14½ x 18	710	300	BS	A	TC	D	245	56	120½	65000
8-18	M-S	4	8	14½ x 18	665	300	BS	A	..	D	292	56	120½	80000
8-18TS	M-S	4	8	14½ x 18	945	300	BS	A	TC	D	292	56	120½	82500
6-20	M-S	4	6	16 x 20	640	277	BS	A	..	D	264	61	133	82000
6-20TS	M-S	4	6	16 x 20	885	277	BS	A	TC	D	264	61	133	85000
8-20	M-S	4	8	16 x 20	850	277	BS	A	..	D	321	61	133	103000
8-20TS	M-S	4	8	16 x 20	1180	277	BS	A	TC	D	321	61	133	106000

Engines have open combustion chamber. All are for both marine and stationary use. Lengths and weights are for marine engines. All marine models are direct reversing except 3 and 4-cyl. units which have reverse gear.

Waukesha Motor Company
Waukesha, Wisc.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
140-HK	S-P	4	6	4½ x 5½	100	2000	B	H-EL	..	..	..	..	..	1550
145-HK	S-P	4	6	5¼ x 6	146	1800	B	H-EL	..	..	..	..	..	1865
6-WAKH	S-P	4	6	6¼ x 6½	199	1600	B	EL-G	..	..	..	..	..	3200
6-NKH	S-P	4	6	7 x 8½	250	1050	B	EL-G	..	..	..	..	..	6200
180-DAC*	S-P	4	4	3⅝ x 3¾	35	2400	B	H-EL	..	..	..	..	..	480
185-DAC*	S-P	4	6	3⅝ x 3¾	51	2200	B	EL	..	..	..	..	..	
190-DLC*	S-P	4	6	3¾ x 4	76	2400	B	H-EL	..	..	..	..	..	715
135-DL*	S-P	4	6	4½ x 5	135	2800	B	EL	..	..	..	..	..	1075
140-DK*	S-P	4	6	4½ x 5½	147	2200	B	EL	..	..	..	..	..	
148-DK*	S-P	4	6	5¼ x 6	198	2000	B	EL-G	..	..	..	..	..	2300
6-WAKD*	S-P-M	4	6	6¼ x 6½	240	1600	B	EL-G	..	..	..	..	..	3850
6-NKD*	S-P	4	6	7 x 8½	263	1050	B	EL-G	..	..	..	..	..	
6-LRD*	S-P	4	6	8½ x 8½	386	1050	B	EL-G	..	..	..	..	..	9600

Models marked (*) are full-diesel cycle engines, all others Hesselman low compression, spark ignition oil engines. All models suitable for stationary and mobile use. Hp. ratings are maximum. Rpm at maximum Hp. is shown.

White-Roth Machine Corp.
Lorain, Ohio

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. H.P.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
LD	S	2	1	7½ x 8	22	600	B	A	..	..	72	48	53	2600
OD	S	2	1	9½ x 10	33	450	B	A	..	..	88	58	59	3630
AD	S	2	1	13 x 13	57	325	B	A	..	..	110	74	68	8300

Witte Engine Works
Division Oil Well Supply Company
Kansas City, Missouri

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
AD	S-P	4	1	3¼ x 4½	4-6.8	1200-1800	DM-B	H-EL	..	..	23½	23½	32⅝	450
BD	S-P	4	1	4¼ x 6	8	900	DM-B	H	..	..	45⅛	33⅛	27⅜	930
LD	S-P	4	1	4¾ x 5¼	9	1350	DM-B	H-EL	..	..	28⅞	28	43½	842
CD	S-P	4	1	5 x 8	12	700	B	H	..	..	52¾	36	36⅛	1352
LDM	M	4	1	4¾ x 5¼	9	1350	DM-B	H-EL	..	S	45	24⅞	43⅞	1100

All engines have pre-combustion chambers. Designations indicate a series built in several different models determined by type of cooling equipment and power take-off.

Wolverine Motor Works, Inc.
Bridgeport, Conn.

Model	Use	Cycle	No. of Cyl.	Bore & Stroke In.	Cont. H.P.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
....	M	2	2	6⅝ x 8½	25- 30	425-500	BS	A	..	O	79¾	..	..	4035
....	M	2	3	6⅝ x 8½	38- 45	425-500	BS	A	..	O	92⅝	..	..	4985
....	M	2	4	6⅝ x 8½	50- 60	425-500	BS	A	..	O	105½	..	..	6075
....	M	2	6	6⅝ x 8½	75- 90	425-500	BS	A	..	D	112	..	..	7200
....	M-S	4	3	8½ x 10½	110-120	600-650	BS	A	..	S	97	..	..	8300
....	M-S	4	4	8½ x 10½	145-160	600-650	BS	A	..	S	110	..	..	9500
....	M-S	4	5	8½ x 10½	185-200	600-650	BS	A	..	S	124	..	..	10400
....	M-S	4	6	8½ x 10½	225-240	600-650	BS	A	..	S	137	..	..	11600
....	M-S	4	8	8½ x 10½	300-320	600-650	BS	A	..	S	180*	..	..	13800
....	M-S	4	3	8½ x 12½	75- 90	360-400	O	A	..	O	117	..	..	11300
....	M-S	4	4	8½ x 12½	100-120	360-400	O	A	..	O	133⅛	..	..	12000
....	M-S	4	4	8¾ x 13	120-140	360-400	O	A	..	O	143⅛	..	..	13500
....	M	4	4	9¼ x 14	140-160	360-400	O	A	..	O	146½	..	..	15000
....	M	4	5	9¼ x 14	175-200	360-400	O	A	..	D	127⅛	..	..	18500
....	M	4	6	9¼ x 14	210-240	360-400	O	A	..	D	143¾	..	..	19000
....	M	4	8	9¼ x 14	280-320	360-400	O	A	..	D	176	..	..	24000

**With reverse and 2 to 1 reduction gear.*

Worthington Pump & Machinery Corporation
Harrison, New Jersey

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
BB5	S-P	4	5	8 x 10½	150	600	..	A	..	..	..	..	..	...
BB6	S-P	4	6	8 x 10½	180	600	..	A	..	..	..	..	..	...
CC5	S-P	4	5	10⅜ x 14½	345	514	..	A	..	..	..	..	..	...
CC6	S-P	4	6	10⅜ x 14½	410	514	..	A	..	..	..	..	..	...
CC7	S-P	4	7	10⅜ x 14½	480	514	..	A	..	..	..	..	..	...
CC8	S-P	4	8	10⅜ x 14½	550	514	..	A	..	..	..	..	..	...
SCC5	S-P	4	5	10⅜ x 14½	515	514	..	A	TC	..	..	..	..	...
SCC6	S-P	4	6	10⅜ x 14½	615	514	..	A	TC	..	..	..	..	...
SCC7	S-P	4	7	10⅜ x 14½	720	514	..	A	TC	..	..	..	..	...
SCC8	S-P	4	8	10⅜ x 14½	825	514	..	A	TC	..	..	..	..	...
DD5	S	4	5	13¼ x 17½	435	360	..	A	..	..	..	..	..	...
DD6	S	4	6	13¼ x 17½	525	360	..	A	..	..	..	..	..	...
DD7	S	4	7	13¼ x 17½	615	360	..	A	..	..	..	..	..	...
DD8	S	4	8	13¼ x 17½	700	360	..	A	..	..	..	..	..	...
SDD5	S	4	5	13¼ x 17½	660	360	..	A	TC	..	..	..	..	...
SDD6	S	4	6	13¼ x 17½	790	360	..	A	TC	..	..	..	..	...
SDD7	S	4	7	13¼ x 17½	925	360	..	A	TC	..	..	..	..	...
SDD8	S	4	8	13¼ x 17½	1055	360	..	A	TC	..	..	..	..	...
DH5	S-P	4	5	12 x 14	480	600	..	A	..	..	..	..	..	...
DH6	S-P	4	6	12 x 14	575	600	..	A	..	..	..	..	..	...
DH7	S-P	4	7	12 x 14	670	600	..	A	..	..	..	..	..	...
DH8	S-P	4	8	12 x 14	765	600	..	A	..	..	..	..	..	...
SDH5	S-P	4	5	12 x 14	720	600	..	A	TC	..	..	..	..	...
SDH6	S-P	4	6	12 x 14	865	600	..	A	TC	..	..	..	..	...
SDH7	S-P	4	7	12 x 14	1010	600	..	A	TC	..	..	..	..	...
SDH8	S-P	4	8	12 x 14	1155	600	..	A	TC	..	..	..	..	...
DR5	S	4	5	13¼ x 17½	550	450	..	A	..	..	..	..	..	...
DR6	S	4	6	13¼ x 17½	660	450	..	A	..	..	..	..	..	...
DR7	S	4	7	13¼ x 17½	770	450	..	A	..	..	..	..	..	...
DR8	S	4	8	13¼ x 17½	880	450	..	A	..	..	..	..	..	...
SDR5	S	4	5	13¼ x 17½	825	450	..	A	TC	..	..	..	..	...
SDR6	S	4	6	13¼ x 17½	990	450	..	A	TC	..	..	..	..	...
SDR7	S	4	7	13¼ x 17½	1155	450	..	A	TC	..	..	..	..	...
SDR8	S	4	8	13¼ x 17½	1320	450	..	A	TC	..	..	..	..	...
EH5	S	4	5	16 x 20	730	360	..	A	..	..	..	..	..	...
EH6	S	4	6	16 x 20	880	360	..	A	..	..	..	..	..	...
EH7	S	4	7	16 x 20	1025	360	..	A	..	..	..	..	..	...
EH8	S	4	8	16 x 20	1170	360	..	A	..	..	..	..	..	...
EH10	S	4	10	16 x 20	1460	360	..	A	..	..	..	..	..	...
EH12	S	4	12	16 x 20	1760	360	..	A	..	..	..	..	..	...
EH16	S	4	16	16 x 20	2340	360	..	A	..	..	..	..	..	...
SEH5	S	4	5	16 x 20	1100	360	..	A	TC	..	..	..	..	...
SEH6	S	4	6	16 x 20	1320	360	..	A	TC	..	..	..	..	...
SEH7	S	4	7	16 x 20	1540	360	..	A	TC	..	..	..	..	...
SEH8	S	4	8	16 x 20	1760	360	..	A	TC	..	..	..	..	...
SEH10	S	4	10	16 x 20	2200	360	..	A	TC	..	..	..	..	...
SEH12	S	4	12	16 x 20	2640	360	..	A	TC	..	..	..	..	...
SEH16	S	4	16	16 x 20	3520	360	..	A	TC	..	..	..	..	...
BBM5	M	4	5	8 x 10½	125	500	..	A	M	S	..	..	..	...
BBM6	M	4	6	8 x 10½	150	500	..	A	M	S	..	..	..	...
DHM-5	M	4	5	12 x 14	480	600	..	A	..	*	..	..	..	...
DHM-6	M	4	6	12 x 14	575	600	..	A	..	*	..	..	..	...
DHM-7	M	4	7	12 x 14	670	600	..	A	..	*	..	..	..	...
DHM-8	M	4	8	12 x 14	765	600	..	A	..	*	..	..	..	...
SDHM-5	M	4	5	12 x 14	720	600	..	A	TC	*	..	..	..	...
SDHM-6	M	4	6	12 x 14	865	600	..	A	TC	*	..	..	..	...
SDHM-7	M	4	7	12 x 14	1010	600	..	A	TC	*	..	..	..	...
SDHM-8	M	4	8	12 x 14	1155	600	..	A	TC	*	..	..	..	...

*All engines have open type combustion chambers. *Reverse gear used; make not specified. Dual fuel optional. All ratings are for 60 cycle speeds. For 375 RPM 50 cycle speed, horsepower ratings are increased in direct proportion to the increase in speed.*

Imported Diesels

Aboe, Inc.
Empire State Building
350 Fifth Avenue
New York 1, N. Y.

Model		Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
Petter	AVA1	SP	4	1	3.15 x 4.33	5¼	1800	Bryce	EL-H	..	..	29¾	21	30	390
"	AVA2	SP	4	2	3.15 x 4.33	10½	1800	"	EL-H	..	..	36½	21	31¾	558
"	AV1	SP	4	1	3.15 x 4.33	6	1800	"	EL-H	..	..	29¾	20⅝	29¼	406
"	AV2	SP	4	2	3.15 x 4.33	12	1800	"	EL-H	..	..	36½	20⅝	31¾	598
"	B2T	S-P	4	2	4.33 x 4.33	18	1500	"	EL-H	..	..	32½	24⅝	33	1198
"	B3T	S-P	4	3	4.33 x 4.33	27	1500	"	EL-H	..	..	39½	24⅝	33	1477
"	B4T	S-P	4	4	4.33 x 4.33	36	1500	"	EL-H	..	..	45¾	24⅝	33	1737
Meadows	4DC-330	S-P	4	4	4.724 x 4.724	60	1800	Cav	EL	..	..	38	22½	40	950
"	4DC-420	S-P	4	4	5⅛ x 5⅛	66	1600	"	EL	..	..	42¾	31⅝	43¼	1800
"	4DC-630	S-P	4	6	5⅛ x 5⅛	100	1600	"	EL	..	..	52½	30⅝	41⅝	1790
"	Greenville	M	4	4	5⅛ x 5⅛	65	1650	"	EL	..	..	70½	35	47	2200
"	Frobisher	M	4	6	5⅛ x 5⅛	100	1650	"	EL	..	..	82⅝	35	47	2550
Petter	AV2M	M	4	2	3.15 x 4.33	10	1500	Bryce	EL-H	..	..	48	20	29¼	760
Meadows	970	S-P	4	6	5.9 x 5.9	150	1500	Cav	EL	..	..	63⅝	32½	47½	3500
"	970S	S-P	4	6	5.9 x 5.9	200	1500	"	EL	T-C	..	68	32½	47½	3900
Mirrlees	J6	S-M	4	6	9¾ x 10½	360	720	Bryce	A	T-C	..	..	..	..	.....
"	JS8	S-M	4	8	9¾ x 10½	665	720	"	A	..	..	..	..	..	.....
"	JV12	S-M	4	12	9¾ x 10½	724	720	"	A	..	..	..	..	..	.....
"	JSV16	S-M	4	16	9¾ x 10½	1310	720	"	A	T-C	..	..	..	..	.....
"	K8	S-M	4	8	15 x 18	990	428	"	A	..	..	..	..	..	.....
"	KVS12	S-M	4	12	15 x 18	2160	428	"	A	T-C	..	..	..	..	.....
National	M4A8	S	4	8	6 x 8½	198	1000	Cav	A-EL	..	..	96¾	36	57¾	7160
"	R4AU6	S	4	6	9 x 12	405	600	"	A	T-C	..	127	54⅝	81⅞	18060
"	B4AU8	S	4	8	17 x 21½	1728	333	"	A	T-C	..	298	106	135	133880

The above list is only representative of the sizes and types that ABOE, Inc. manufacture; engines up to 3000 hp. are available.

Bolinders Company, Inc.
33 Rector Street
New York 6, N. Y.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
W3M15	M	2	1	4¾ x 4¾	8–10	900	O	A-EL	..	G	37	..	..	415
W3M25	M	2	2	4¾ x 4¾	16–20	900	O	A-EL	..	G	44⅞	..	..	935
W7M15	M	2	1	7⅛ x 7⅛	25	800	O	A-EL	..	G	43⅝	..	..	1520
W7M25	M	2	2	7⅛ x 7⅛	50	800	O	A-EL	..	G	49⅛	..	..	1985
W7M45	M	2	4	7⅛ x 7⅛	100	800	O	A-EL	..	G	86⅝	..	..	3300
M42EB	M	2	2	.....	80– 100	450– 600	O	A	..	O	100	..	..	8250
M43EB	M	2	3	.....	120– 155	450– 600	O	A	..	O	121	..	..	10500
M44EB	M	2	4	.....	160– 210	450– 600	O	A	..	O	141	..	..	128000
M45EB	M	2	5	.....	200– 265	450– 600	O	A	..	O	155	..	..	1480
M46EB	M	2	6	.....	240– 320	450– 600	O	A	..	O	166	..	..	17200
M44E	M	2	4	.....	160– 210	450– 600	O	A	..	D	104	..	..	11700
M45E	M	2	5	.....	200– 265	450– 600	O	A	..	D	117	..	..	13500
M46E	M	2	6	.....	240– 320	450– 600	O	A	..	D	129	..	..	15100
M47E	M	2	7	.....	280– 375	450– 600	O	A	..	D	145	..	..	16500
M44I	M	2	4	.....	300– 420	300– 425	O	A	..	D	163	..	..	32200
M45I	M	2	5	.....	370– 520	300– 425	O	A	..	D	185	..	..	36600
M46I	M	2	6	.....	450– 630	300– 425	O	A	..	D	203	..	..	40000
M47I	M	2	7	.....	520– 730	300– 425	O	A	..	D	232	..	..	46300
M33M	M	2	4	.....	560– 730	220– 300	O	A	..	D	215	..	..	64600
M45M	M	2	5	.....	700– 910	220– 300	O	A	..	D	246	..	..	78200
M46M	M	2	6	.....	840–1100	220– 300	O	A	..	D	274	..	..	84800
M47M	M	2	7	.....	980–1280	220– 300	O	A	..	D	312	..	..	99000
M48M	M	2	8	.....	1120–1460	220– 300	O	A	..	D	343	..	..	109000

M models have open type combustion chambers. Weight for MEB models include reverse gear. Models W3 and 7 are surface ingition engines of Bolinder manufacture. Balance are of Atlas Polar design sold through Bolinders.

Burmeister & Wain American Corporation
17 Battery Place
New York 4, N. Y.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
450-VT-110	M-S	2	4	19.7 x 43.3	1680	170	O	A	..	D	..	..	..	...
550-VT-110	M-S	2	5	19.7 x 43.3	2100	170	O	A	..	D	..	..	..	...
650-VT-110	M-S	2	6	19.7 x 43.3	2520	170	O	A	..	D	..	..	..	...
750-VT-110	M-S	2	7	19.7 x 43.3	2940	170	O	A	..	D	..	..	..	...
850-VT-110	M-S	2	8	19.7 x 43.3	3360	170	O	A	..	D	..	..	..	...
950-VT-110	M-S	2	9	19.7 x 43.3	3780	170	O	A	..	D	..	..	..	...
1050-VT-110	M-S	2	10	19.7 x 43.3	4200	170	O	A	..	D	..	..	..	...
1150-VT-110	M-S	2	11	19.7 x 43.3	4620	170	O	A	..	D	..	..	..	...
1250-VT-110	M-S	2	12	19.7 x 43.3	5040	170	O	A	..	D	..	..	..	...
462-VT-115	M-S	2	4	24.4 x 45.3	2400	150	O	A	..	D	..	..	..	...
562-VT-115	M-S	2	5	24.4 x 45.3	3000	150	O	A	..	D	..	..	..	...
662-VT-115	M-S	2	6	24.4 x 45.3	3600	150	O	A	..	D	..	..	..	...
762-VT-115	M-S	2	7	24.4 x 45.3	4200	150	O	A	..	D	..	..	..	...
862-VT-115	M-S	2	8	24.4 x 45.3	4800	150	O	A	..	D	..	..	..	...
962-VT-115	M-S	2	9	24.4 x 45.3	5400	150	O	A	..	D	..	..	..	...
1062-VT-115	M-S	2	10	24.4 x 45.3	6000	150	O	A	..	D	..	..	..	...
1162-VT-115	M-S	2	11	24.4 x 45.3	6600	150	O	A	..	D	..	..	..	...
1262-VT-115	M-S	2	12	24.4 x 45.3	7200	150	O	A	..	D	..	..	..	...
474-VT-140	M-S	2	4	29.1 x 55.1	3500	125	O	A	..	D	..	..	..	...
574-VT-140	M-S	2	5	29.1 x 55.1	4375	125	O	A	..	D	..	..	..	...
674-VT-140	M-S	2	6	29.1 x 55.1	5250	125	O	A	..	D	..	..	..	...
774-VT-140	M-S	2	7	29.1 x 55.1	6125	125	O	A	..	D	..	..	..	...
874-VT-140	M-S	2	8	29.1 x 55.1	7000	125	O	A	..	D	..	..	..	...
974-VT-140	M-S	2	9	29.1 x 55.1	7875	125	O	A	..	D	..	..	..	...
1074-VT-140	M-S	2	10	29.1 x 55.1	8750	125	O	A	..	D	..	..	..	...
1174-VT-140	M-S	2	11	29.1 x 55.1	9625	125	O	A	..	D	..	..	..	...
1274-VT-140	M-S	2	12	29.1 x 55.1	10500	125	O	A	..	D	..	..	..	...

Not listed are various types of 4-cycle, 2-cycle and 2-cycle double actin; engines. Inclusion of "S" in designation indicates stationary model; "F" indicates marine.

Crofton Industrial Diesel Engines
San Diego 1, California

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
4/1A	..	4	1	3⅛ x 3⅛	4	1500	B	H-EL	..	..	28*	19	27½	235
5/1W	M-S	4	1	3⅛ x 3⅛	5	1500	B	H-EL	..	..	26⅛	16⅜	26⅝	224
10/2	M-S	4	2	3⅛ x 4¾	10	1800	B	H-EL	..	..	44*	17¾	28½	455

* *Includes starting handle. Ricardo type precombustion system is used.*

MWM Benz Diesel Engines
Ernest L. Frankl Associates
22 E. 40th St., New York 16, N.Y.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
KDW415E	M-S-P	4	1	3⅛ x 5⅜	6- 12	750-1500	D/G	EL-H	..	D	26	21	37	700
KD415Z	M-S-P	4	2	3⅛ x 5⅜	12- 24	750-1500	D/G	EL-H	..	D	29	21	37	930
KD415D	M-S-P	4	3	3⅛ x 5⅜	18- 36	750-1500	D/G	EL-H-A	..	D	37	21	40	1170
TD15	M-S-P	4	2	4¾ x 5⅜	15- 30	750-1500	B/G	EL-H	..	D	26	22	37	990
RH418Z	M-S-P	4	2	5½ x 7⅛	55	1350	B/G	EL-A	..	D	29	29	45	1330
RH418D	M-S-P	4	3	5½ x 7⅛	82- 90	1350-1500	B/G	EL-A	..	D	38	29	45	1660
RH418V	M-S-P	4	4	5½ x 7⅛	110- 120	1350-1500	B/G	EL-A	..	D	48	29	45	1990
RH418S	M-S-P	4	6	5½ x 7⅛	165- 180	1350-1500	B/G	EL-A	..	D	64	29	45	2720
RH418A	M-S-P	4	8	5½ x 7⅛	220- 240	1350-1500	B/G	EL-A	..	D	78	29	45	3450
RH422Z	M-S-P	4	2	5⅝ x 8⅛	36- 45	800-1000	B/G	EL-A	..	D	42	37	52	3060
RH422D	M-S-P	4	3	5⅝ x 8⅛	54- 68	800-1000	B/G	EL-A	..	D	51	37	52	3730
RH422V	M-S-P	4	4	5⅝ x 8⅛	72- 90	800-1000	B/G	EL-A	..	D	61	37	52	4260
RH422S	M-S-P	4	6	5⅝ x 8⅛	110- 150	800-1100	B/G	EL-A	..	D	81	37	52	5860
RH422S	M-P-S	4	6	5⅝ x 8⅛	145- 200	800-1100	B/G	EL-A	TC	D	81	37	52	6520
RH230D	M-S-P	4	3	8⅛ x 11⅛	75- 100	375- 500	B/G	A	..	D	77	42	67	7850
RH230V	M-S-P	4	4	8⅛ x 11⅛	100- 133	375- 500	B/G	A	..	D	91	42	67	9500
RH230S	M-S-P	4	6	8⅛ x 11⅛	150- 290	375- 750	B/G	A	..	DO	120	42	67	12830
RH230S	M-S-P	4	6	8⅛ x 11⅛	260- 310	500- 600	B/G	A	TC	DO	120	42	67	13490
RH134S	M-S-P	4	6	10¼ x 13⅛	330- 400	500- 600	B/G	A	..	DO	128	58	77	17070
RH134S	M-S-P	4	6	10¼ x 13⅛	460- 550	500- 600	B/G	A	TC	DO	128	58	77	18630
RH335S	M-S-P	4	6	9⅞ x 13⅞	300- 360	500- 600	B/G	A	..	DO	128	48	81	14550
RH335S	M-S-P	4	6	9⅞ x 13⅞	440	500	B/G	A	TC	DO	128	48	81	15210
RH348V	M-S-P	4	4	12⅛ x 18⅞	265- 295	300- 333	B/G	A	..	D	128	57	106	27450
RH348S	M-S-P	4	6	12⅛ x 18⅞	400- 500	300- 375	B/G	A	..	DO	170	59	106	37480
RH348S	M-S-P	4	6	12⅛ x 18⅞	700	375	B/G	A	TC	DO	170	59	106	38470
RH348A	M-S-P	4	8	12⅛ x 18⅞	530- 660	300- 375	B/G	A	..	O	221	59	106	46520
RH348A	M-S-P	4	8	12⅛ x 18⅜	920	375	B/G	A	TC	O	221	59	106	47990

"DG" Fuel equipment made by Deckel, Germany; "BG" made by Bosch, Germany.

Sulzer Bros. Ltd., New York
50 Church Street
New York 7, N. Y.

Model	Use	Cycle	No. Cyl.	Bore & Stroke In.	Cont. HP.	Cont. R.P.M.	Fuel System	Start	Super-Charge	Rev. Gear	Length In.	Width In.	Height In.	Weight Lb.
3BA22	S	4	3	8.67 x 12.6	210	600	O	A	TC	..	..	..	..	...
4BA22	S	4	4	8.67 x 12.6	275	600	O	A	TC	..	..	..	..	...
5BA22	S	4	5	8.67 x 12.6	350	600	O	A	TC	..	..	..	..	...
6BA22	S	4	6	8.67 x 12.6	450	600	O	A	TC	..	..	..	..	...
8BA22	S	4	8	8.67 x 12.6	600	600	O	A	TC	..	..	..	..	...
6BA29	S	4	6	11.4 x 14.4	700	500	O	A	TC	..	..	..	..	...
7BA29	S	4	7	11.4 x 14.4	800	500	O	A	TC	..	..	..	..	...
8BA29	S	4	8	11.4 x 14.4	950	500	O	A	TC	..	..	..	..	...
4T36	S	2	4	14.4 x 23.6	800	300	O	A	..	..	..	..	..	...
5T36	S	2	5	14.4 x 23.6	1000	300	O	A	..	..	..	..	..	...
6T36	S	2	6	14.4 x 23.6	1200	300	O	A	..	..	..	..	..	...
8T36	S	2	8	14.4 x 23.6	1600	300	O	A	..	..	..	..	..	...
4TPF48	S	2	4	18.9 x 27.5	1400	250	O	A	..	..	..	..	..	...
5TPF48	S	2	5	18.9 x 27.5	1750	250	O	A	..	..	..	..	..	...
6TPF48	S	2	6	18.9 x 27.5	2100	250	O	A	..	..	..	..	..	...
7TPF48	S	2	7	18.9 x 27.5	2450	250	O	A	..	..	..	..	..	...
8TPF48	S	2	8	18.9 x 27.5	2800	250	O	A	..	..	..	..	..	...
10TPF48	S	2	10	18.9 x 27.5	3500	250	O	A	..	..	..	..	..	...
12TPF48	S	2	12	18.9 x 27.5	4200	250	O	A	..	..	..	..	..	...
6SF72	S	2	6	28.3 x 35.4	4500	187	O	A	..	..	..	..	..	...
8SF72	S	2	8	28.3 x 35.4	6000	187	O	A	..	..	..	..	..	...
10SF72	S	2	10	28.3 x 35.4	7500	187	O	A	..	..	..	..	..	...
12SF72	S	2	12	28.3 x 35.4	9000	187	O	A	..	..	..	..	..	...
4TW24	M	2	4	9.46 x 15.75	300	400	O	A	..	G	..	..	..	...
6TW24	M	2	6	9.46 x 15.75	450	400	O	A	..	G	..	..	..	...
6TD24	M	2	6	9.46 x 15.75	450	400	O	A	..	..	..	..	..	...
6TD29	M	2	6	11.4 x 19.75	600	300	O	A	..	..	..	..	..	...
7TD29	M	2	7	11.4 x 19.75	700	300	O	A	..	..	..	..	..	...
8TD29	M	2	8	11.4 x 19.75	800	300	O	A	..	..	..	..	..	...
9TD29	M	2	9	11.4 x 19.75	900	300	O	A	..	..	..	..	..	...
5TD36	M	2	5	14.4 x 23.6	750	250	O	A	..	..	..	..	..	...
6TD36	M	2	6	14.4 x 23.6	900	250	O	A	..	..	..	..	..	...
7TD36	M	2	7	14.4 x 23.6	1050	250	O	A	..	..	..	..	..	...
8TD36	M	2	8	14.4 x 23.6	1200	250	O	A	..	..	..	..	..	...
10TD36	M	2	10	14.4 x 23.6	1500	250	O	A	..	..	..	..	..	...
5TPD48	M	2	5	18.9 x 27.5	1500	225	O	A	..	..	..	..	..	...
6TPD48	M	2	6	18.9 x 27.5	1800	225	O	A	..	..	..	..	..	...
10TPD48	M	2	10	18.9 x 27.5	3000	225	O	A	..	..	..	..	..	...
12TPD48	M	2	12	18.9 x 27.5	3600	225	O	A	..	..	..	..	..	...
6SD60	M	2	6	23.6 x 41	3000	150	O	A	..	..	..	..	..	...
7SD60	M	2	7	26.6 x 41	3500	150	O	A	..	..	..	..	..	...
8SD60	M	2	8	23.6 x 41	4000	150	O	A	..	..	..	..	..	...
9SD60	M	2	9	23.6 x 41	4500	150	O	A	..	..	..	..	..	...
10SD60	M	2	10	23.6 x 41	5000	150	O	A	..	..	..	..	..	...
6SD72	M	2	6	28.3 x 49.3	4200	125	O	A	..	..	..	..	..	...
7SD72	M	2	7	28.3 x 49.3	4900	125	O	A	..	..	..	..	..	...
8SD72	M	2	8	28.3 x 49.3	5600	125	O	A	..	..	..	..	..	...
9SD72	M	2	9	28.3 x 49.3	6300	125	O	A	..	..	..	..	..	...
10SD72	M	2	10	28.3 x 49.3	7000	125	O	A	..	..	..	..	..	...
11SD72	M	2	11	28.3 x 49.3	7700	125	O	A	..	..	..	..	..	...
12SD72	M	2	12	28.3 x 49.3	8400	125	O	A	..	..	..	..	..	...
6LDA19	P	4	6	7.5 x ...	420	1100	O	EL	TC	..	..	..	..	...
6LDA22	P	4	6	8.67 x ...	570	950	O	EL	TC	..	..	..	..	...
6LDA25	P	4	6	9.85 x ...	735	850	O	EL	TC	..	..	..	..	...
8LDA25	P	4	8	9.85 x ...	960	850	O	EL	TC	..	..	..	..	...
6LDA28	P	4	6	11.0 x ...	915	750	O	EL	TC	..	..	..	..	...
8LDA28	P	4	8	11.0 x ...	1200	750	O	EL	TC	..	..	..	..	...
12LDA31	P	4	12	12.3 x ...	2250	935#	O	EL	TC	..	..	..	..	...

#—Number of R.P.M. of the generator.

Maintenance Costs and Considerations of Large Engines in Power Generation

by J. Bryan Sims

The first part of this article, presented last month, discussed maintenance of the engine, standardization of maintenance procedures, examples of minor improvement possibilities and maintenance in the combustion area. This part starts with considerations of condensation and chemical reaction.

Mr. Sims, superintendent, Board of Public Works, Grand Haven, Mich., presented this text at the 1950 Midwest Power Conference. This meeting was sponsored by the Illinois Institute of Technology in cooperation with a number of colleges, universities and technical societies. Length of the text, all of interest, necessitated presentation in two parts, this being the second portion. The first part was presented last month.

CONDENSATION within the cylinder depends upon many factors including humidity of intake air, cylinder pressure and temperature variations, surface temperatures of cylinder walls, etc. The dew point may vary during the cycle of operation and this greatly influences the chemical reactions inside the cylinder.

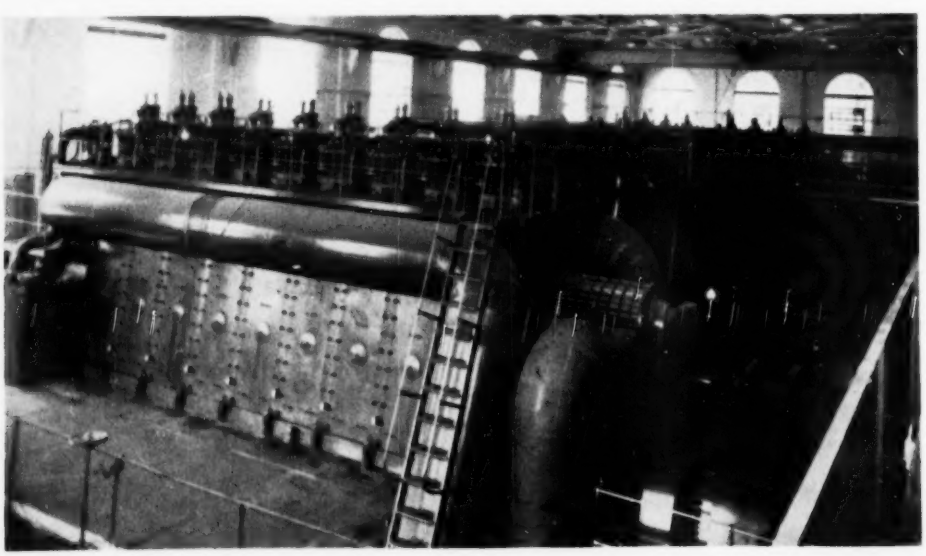
These chemical reactions are complex and there is considerable conjecture concerning their nature and the wear that they cause. There is little doubt, however, that oxidation of the iron occurs and that the minute particles of displaced metal or material itself caused by wear contributes further to chemical reactions, particularly where difficult fuels are encountered.

Lubrication Problems May Have Possibilities

All operators are familiar with lubrication problems and the competitive lubricating oil situation where many an ambitious lubricating oil sales engineer may be ready and willing to assume the responsibility of meeting a wear situation, not always due to the lubricating oil itself, but more often to a combination of factors. Very often, however, improvements may be made in lubrication, even by the correct application of a different type of oil and it is difficult to evaluate the improvement of one brand or type over the other. One may be inclined to jump at conclusions based upon generalities or perhaps unjustifiable prejudice.

Recently, in a practical effort to evaluate results of several types of lubricating oils in the cylinders of large 2-cycle engines experiencing aggravated liner and ring wear due in no small measure to the burning of a relatively low grade straight run residual fuel oil from a nearby refinery, different types of lubricating oils were run for months under as near as possible identical conditions.

Three test periods were run on two different 2-cycle, 9-cyl., large bore, cross head engines having separate lubricators furnishing cylinder lubricant for each cylinder. Thus the upper cylinder lubricating system is entirely separate from the crank case lubrication and piston cooling oil, making it possible to use different oils on each cylinder.



Engine room of the Grand Haven plant. Comparison tests of oils were run on engines 2 and 6. Test results are given in the text.

A test was run on engine No. 6 for about 1700 hours using three different types of lubricating oils. Two different manufacturers were represented. As will be noted from Table I, cyls. 1, 2 and 3 used a standard brand of naphthenic base lube oil without additives and designated as "A". Cyls. 4, 5 and 6 used a more recently developed and considerably more expensive oil with additive designated as "I". Cyls. 7, 8 and 9 ran on the same manufacturer's oil but of a different type and using less additives. This oil was less expensive to the customer than "I" and is designated a "O".

With these three different oils from two suppliers being used on three cylinders each, micrometer readings were made at the start of the run on the bore of each liner at three positions. There were: No. 1—1½ in. below top piston ring travel; No. 2—3½ in. below and No. 3—7½ in. below.

The engine was operated under normal conditions of service for the period noted. At the end of this period, heads were pulled and micrometer readings were again taken in the same positions to determine the amount of wear. It was endeavored to make wear readings under reasonably close temperature conditions. All readings were made by the same maintenance mechanic. Results were tabulated and studied. Afterwards when studying the results, two of the readings looked so unusual that they were questioned, and a later reading indicated that they were incorrect; therefore, they were not used in averaging the wear rates.

Another test was made on three cylinders of engine No. 2, a duplicate of engine No. 6, that in normal service ran more continuously than the latter engine and was, therefore, not subjected to as many starts and stops during the test period. The average *initial* liner wear was not as great as that on engine No. 6 used in the prior test and it is felt that this might have influenced the results to some extent.

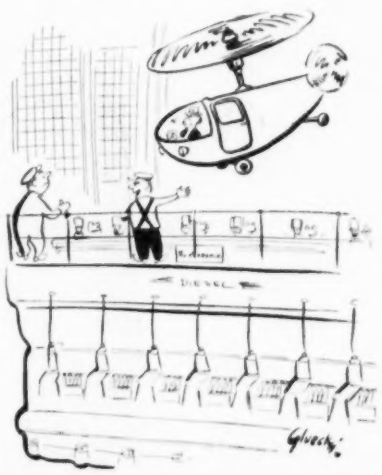
It was regrettable that it was not practical to run all the oils at one time on the same engine under duplicate conditions. Prior to the second test, engine No. 2 had been operating with oil "A" on all cylinders. At the start of the test, micrometer readings were taken on three cylinders as noted in Table II and these three cylinders used oil "P" for the period noted. Oil "P" was of the same manufacturer as "A," but of paraffinic base and was not an additive type.

Although the oils were not run on the same engine and under the same conditions, they were graphed together in Fig. 1 in order to indicate what the savings might be in the amount of liner and ring wear by improving lubrication.

Later another test on engine No. 6 was run for a period of 2458 hours as noted in Table III. Cyls. 1, 2 and 8 used oil "A" and cyls. 7, 8 and 9 used oil "O" (additive type). It will be noted from Fig. 2 that the liners using oil "O" showed considerably less wear than the cylinders using "A".

It was felt that these tests, far from being conclusive, indicated a distinct possibility of reducing maintenance and, therefore, operating expense and it is planned to pursue these practical tests to a point where more thorough conclusions can be made. The tests were begun with the suspicion that some of the wear was being caused by an acid condition accompanying the burning of fuel having a fair amount of sulphur or from other corrosive or erosive action. Therefore, the first test was to try an oil with an acid inhibitor, ("I" & "O"). Afterwards it was decided to use the fourth oil, "P", a straight paraffinic base oil on engine No. 2. An analysis of the carbon found in the exhaust port is shown in the illustrations.

"The worst part about working in a municipal plant is that the taxpayers are always checking up to see if you're earning your salary."



Approach to the solving of the ring and liner wear problem has been from the acid and ash viewpoint. Engine operating temperatures have been increased recognizing that carbon dioxide, one of the products of combustion, is absorbed by the condensed water (another product of combustion) forming carbonic acid; sulphur dioxide will likewise form sulfurous acid. Both corrode cylinder walls, causing wear. This condition is aggravated by frequent starting and stopping.

It is felt that the salt may burn off into ash, resulting in abrasive action and that further filtration and treatment of the fuel may be desirable. There is, however, always an economic limit to the amount of treatment justified.

In burning the more viscous and difficult fuels, it appears that there is an opportunity for much constructive work to be done in the field of practical filtration and treatment in the power plant. To ask the refiner to do this often results in the placing of the fuels into a special category and out of the normal industrial fuel oil class with perhaps resultant higher cost. It is difficult to prove that reduced maintenance could offset the additional cost of specially prepared diesel fuel.

Laboratory tests of this straight run residual 24.1 A. P. I. fuel indicated the following:

BEFORE CENTRIFUGING

Sulphur	*0.75%*
Neut.	*0.19%*
Mineral Acidity	*0*

AFTER CENTRIFUGING

Sulphur	*0.69%*
Neut.	*0.13*
Mineral Acidity	*0*

This is a topped crude residual

TABLE I

Test Showing Effect of Oil on Cylinder Liner Wear
Board of Public Works, Grand Haven, Michigan

Engine No. 6

Cylinder Number	Oil	Date Inspected	Bore Dia. Parallel to Crank (Inches) Position 1	Position 2	Position 3	Bore Dia. Perpendicular to Crank (Inches) Position 1	Position 2	Position 3
1—End of Test	A	9/9/49	21.583	21.5695	21.550	21.5715	21.565	21.5475
Beginning of Test		4/29/49	21.556	21.5465	21.531	21.551	21.547	21.532
Difference			.027	.0230	.019	.0205	.018	.0155
2—End of Test	A	9/9/49	21.579	21.5655	21.5415	21.572	21.561	21.5425
Beginning of Test		4/29/49	21.5525	21.545	21.529	21.545	21.541	21.526
Difference			.0265	.0205	.0125	.027	.020	.0165
3—End of Test	A	9/2/49	21.575	21.573	21.548	21.572	21.568	21.547
Beginning of Test		4/29/49	21.55275	21.55275	21.533	21.548	21.54925	21.5315
Difference			.02225	.02025	.015	.024	.01875	.0155
4—End of Test	I	9/9/49	21.56975	21.55925	21.543	21.56175	21.5545	21.543
Beginning of Test		4/29/49	21.557	21.546	21.5325	21.544	21.537	21.53125
Difference			.01275	.01325	.0105	.01775	.0175	.01175
5—End of Test	I	9/9/49	21.5585	21.549	21.541	21.568	21.558	21.5375
Beginning of Test		4/29/49	21.5575	21.547	21.529	21.5485	21.538	21.533
Difference			.0010	.002	.012	.0195	.020	.0045
6—End of Test	I	9/9/49	21.576	21.562	21.540	21.565	21.555	21.5395
Beginning of Test		4/29/49	21.558	21.547	21.533	21.5495	21.541	21.5335
Difference			.018	.015	.007	.0155	.014	.0060
7—End of Test	O	9/2/49	21.589	21.574	21.5425	21.577	21.563	21.541
Beginning of Test		4/29/49	21.569	21.550	21.533	21.5585	21.546	21.534
Difference			.020	.024	.0095	.0185	.017	.007
8—End of Test	O	9/2/49	21.570	21.564	21.538	21.568	21.552	21.534
Beginning of Test		4/29/49	21.561	21.549	21.5305	21.5455	21.537	21.52575
Difference			.009	.015	.0075	.0145	.015	.00825
9—End of Test	O	9/9/49	21.567	21.5645	21.5355	21.565	21.563	21.541
Beginning of Test		4/29/49	21.553	21.551	21.533	21.551	21.5495	21.5335
Difference			.014	.0135	.0025	.014	.0135	.0095

fuel oil having the following general specifications:

Fire 410F
Flash 345F
Vis. @ 100 F 403
Pour Point 60F
Ash 0.01%
Conradson Carbon .....3 to 5%
Salt .....35/50 lbs./1000 Bbls.
Cetane 42

It will be noted that the sulphur content was slightly lower after centrifuging than before. It is possible that this might be explained by assuming that some solids containing sulphur were removed by centrifuging. It has been found that, apparently due to the wax content, it appears preferable to limit the heating of the fuel prior to centrifuging to a maximum of 100-130° F range.

It is noticeable that there are acid conditions which may vary due to lack of uniformity in the fuel. After centrifuging, the fuel is passed through Nugent bag filters into steam heated conical bottom settling tanks. Some trouble has been experienced with deterioration of the bags in the filters and yet mineral acidity and corrosion tests taken periodically do not always indicate excessive acidity.

Following combustion, however, it is quite apparent that acid conditions do persist and while sulphuric acid is suspected as being the most corrosive, others including hydrogen sulphide (H_2S), Sulphurous (H_2SO_3) and hydrochloric (HCL), or even carbonic (H_2CO_3) may, in various forms and combinations thereof, contribute to oxidation and resultant wear.

Evaluating Results

It may be interesting to note that the relative cost of the oils was as follows: "A"—naphthenic; "P"—paraffinic; "O"—additive type and "I"—additive type. It would appear, therefore, that "A", while lower in cost per gallon, may be expensive in ring and liner wear, and that "P" or "O", while not as expensive as "I", may be equally as efficient in preventing wear. More conclusive tests will be run between "O" and "P". Also, it is planned to test others.

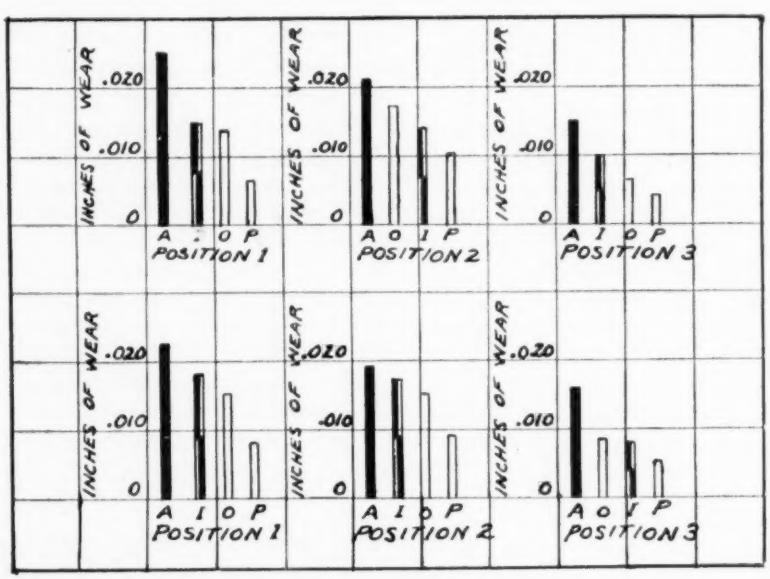


TABLE II

Test Showing Comparative Liner Wear
With Two Different Lubricating Oils on Two Similar Engines

Cylinder Number	Oil	Date Inspected	Bore Dia. Parallel to Crank (Inches) Position 1	Position 2	Position 3	Bore Dia. Perpendicular to Crank (Inches) Position 1	Position 2	Position 3
Engine No. 6								
1—End of Test	A	9/9/49	21.583	21.5695	21.550	21.5715	21.565	21.5475
Beginning of Test		4/29/49	21.556	21.5465	21.531	21.551	21.547	21.532
Difference			.027	.023	.019	.0205	.018	.0155
2—End of Test	A	9/9/49	21.574	21.5655	21.5415	21.572	21.561	21.5425
Beginning of Test		4/29/49	21.5525	21.545	21.529	21.545	21.541	21.526
Difference			.0265	.0205	.0125	.027	.020	.0165
3—End of Test	A	9/9/49	21.575	21.573	21.548	21.572	21.568	21.547
Beginning of Test		4/29/49	21.55275	21.55275	21.533	21.548	21.54925	21.5315
Difference			.02225	.02025	.015	.024	.01875	.0155
Engine No. 2								
2—End of Test	P	1/16/50	21.533	21.5325	21.52275	21.528	21.521	21.5195
Beginning of Test		10/5/49	21.522	21.516	21.516	21.518	21.514	21.514
Difference			.011	.0165	.00675	.010	.007	.0055
7—End of Test	P	1/16/50	21.562	21.5605	21.5195	21.56275	21.561	21.5355
Beginning of Test		10/5/49	21.551	21.547	21.5125	21.552	21.5475	21.528
Difference			.011	.0125	.007	.01075	.0135	.0075
9—End of Test	P	1/16/50	21.552	21.550	21.530	21.550	21.546	21.5265
Beginning of Test		10/5/49	21.547	21.5415	21.527	21.543	21.53625	21.522
Difference			.005	.0085	.003	.007	.01025	.0045

Note—Engine No. 6 experienced more intermittent operation than Engine No. 2. Hours run on No. 6: 1700. Hours run on No. 2: 1991. (Interpolation was made for 1700 hrs. on graph Fig. A for oil "P".)

Preceding the lubricating oil tests, a study was made of the accumulated liner and ring wear cost over a period of years burning difficult fuels, assuming costs of replacement as follows:

New liner .....$1,295.00 ea.
New rings .....$9.00 ea.
Labor, hr. .....1.36 (Average)
Ring installation ..... 12 manhours
Cost new liner instal. $1,382.00
Cost new rings instal. $61.00

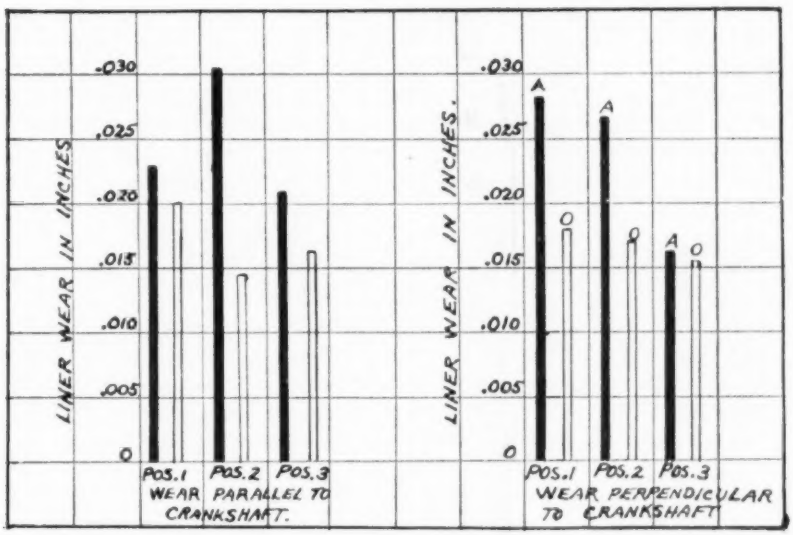
(1) Generally speaking, the initial liners appeared to have, on the average, slightly longer life than replacement liners. This was difficult to explain but might be attributed to several reasons, among them, the fact that the engine's injection system and other parts were perhaps in better condition during the first years of its life. Also, the ring grooves in the pistons may have been in better condition when new, allowing better sealing.

TABLE III

Test Showing Effect of Oil on Cylinder Liner Wear
Board of Public Works, Grand Haven, Michigan

Engine No. 6

Cylinder Number	Oil	Date Inspected	Bore Dia. Parallel to Crank (Inches) Position 1	Position 2	Position 3	Bore Dia. Perpendicular to Crank (Inches) Position 1	Position 2	Position 3
1—End of Test	A	3/13/50	21.602	21.5875	21.5635	21.58925	21.58125	21.5575
Beginning of Test		9/9/49	21.583	21.5465	21.531	21.551	21.547	21.532
Difference			.019	.041	.0325	.03825	.03425	.0255
2—End of Test	A	3/16/50	21.6005	21.592	21.55575	21.5905	21.583	21.5525
Beginning of Test		9/9/49	21.579	21.5655	21.5415	21.572	21.561	21.5425
Difference			.0215	.0263	.01425	.0185	.022	.010
3—End of Test	A	3/13/50	21.6035	21.597	21.56325	21.599	21.5915	21.560
Beginning of Test		9/2/49	21.575	21.573	21.548	21.572	21.568	21.547
Difference			.0285	.024	.01525	.027	.0235	.013
Average			.023	.0303	.0207	.0279	.0266	.0162
7—End of Test	O	3/13/50	21.623	21.6025	21.5615	21.597	21.58475	21.5535
Beginning of Test		9/2/49	21.589	21.574	21.5425	21.577	21.563	21.541
Difference			.034	.0285	.019	.020	.02175	.0125
8—End of Test	O	3/13/50	21.581	21.57675	21.54675	21.580	21.570	21.541
Beginning of Test		9/2/49	21.570	21.564	21.538	21.560	21.552	21.534
Difference			.011	.01275	.01075	.820	.018	.007
9—End of Test	O	3/13/50	21.582	21.5775	21.5565	21.579	21.5735	21.553
Beginning of Test		9/9/49	21.567	21.5645	21.5355	21.565	21.563	21.541
Difference			.015	.013	.021	.014	.0105	.012
Average			.020	.0148	.0169	.018	.0168	.0105



Comparative liner wear with two oils above and four oils at left. Top and bottom graphs and measured parallel and perpendicular to shaft, respectively.

(2) Local conditions such as a change in the type of fuel or lube oil may have had an influence. Indications were that the frequency of piston pulling and ring replacement becomes more pronounced as the wear accumulated and finally it becomes necessary to pull and replace the liner. A further study indicates that in several instances it would have been more economical to have replaced the liner earlier.

(3) In several instances the liner's life was exceptionally short. This was due to a siege of broken liners which was in part traced to air getting into the cooling water system from an air cooler causing poor circulation and inadequate cooling.

TABLE IV

STUDY OF OPERATING COSTS

Plant "A" 600 Psi Coal Burning Steam Plant 15,000 Kw
Vs.
Plant "B" Heavy Fuel Oil Diesel Engine Plant 13,500 Hp

		1943	1944	1945	1946	1947	1948
Total Power Gen.	A	28,321,382	31,467,000	29,951,800	32,060,700	35,462,400	17,006,800
Total Power Gen.	B	15,915,000	16,332,400	16,620,700	18,359,400	21,967,100	25,688,670
Cost of Fuel	A	$ 91,386.09	107,528.90	115,351.25	130,233.75	178,652.73	229,235.23
Cost of Fuel	B	$ 62,569.77	69,186.64	67,928.11	74,149.27	115,684.58	200,567.73
Tons Coal Used	A	17,221	19,142	19,402	21,590	24,669	25,792
Gals. Oil Used	B	1,421,897	1,446,219	1,407,844	1,567,550	1,888,085	2,153,105
Lbs. per kwhr	A	1.22	1.22	1.296	1.347	1.391	1.393
Kwhr per Gal.	B	11.19	11.29	11.80	11.71	11.634	11.9309
Fuel Cost per kwhr Gen.	A	$ 0.00322	.00341	.00385	.00406	.00504	.00619
Fuel Cost per kwhr Gen.	B	$ 0.00392	.00423	.00408	.00404	.00526	.00781
Fuel Cost per kwhr	A		Average $0.00431 (For 6 yrs.)				
Fuel Cost per kwhr	B		Average $0.00489 (For 6 yrs.)				
Max. Kw Peak	A	7,000	8,400	8,400	8,500	9,400	9,600
Max. Kw Peak	B	3,800	4,200	3,950	5,000	5,200	6,300
Average Load Kw	A	3,245	3,802	3,657	3,907	4,287	4,485
Average Load Kw	B	1,815	1,852	1,900	2,108	2,527	2,970

Comparison of Costs

While these rates of wear and replacement costs may appear high to many who are operating smaller units on clean distillate fuels, Table IV showing comparative operating and maintenance costs between a 13,500-hp. diesel generating plant burning a fairly heavy straight run residual fuel oil and a 15,000 kw, 600 psi. steam-electric generating plant burning coal on stokers, and located in the same geographic area may be interesting to il-

lustrate where major differences in cost appear.

Data taken for the comparison was from annual operating reports of each plant and while there may be some variable factors affecting the comparative figures slightly one way or another, it is believed that they are reasonably representative of each plant's operating costs, and are shown to illustrate a point.

It will be noted that the average maintenance cost per kw. hr. generated for each plant over a period of 6 years is very close. The labor cost for operating is also reasonably close (probably reflecting difference in wage scale). However, the 6 year average fuel cost per kw. hr. generated for the steam plant was .00431 and for the diesel plant .00489.

This difference in fuel cost confirms the author's contention that, generally speaking, if the heavy duty, larger sized diesel engine plant is to operate competitively with a fairly efficient steam plant it must look to its fuel cost more closely. The diesel has been improved to where one or two more kw. hr. can be generated per gal. of fuel than was possible a few years ago but unfortunately this has generally been possible by using a lighter higher priced fuel oil. In many cases the increased cost of the fuel has more than offset the increase in economy.

Lacking Gas, Larger Plants Must Look To Heavy Fuel Oils

It would seem, therefore, that where lower priced per Btu. gas is not available that the larger plant must necessarily look to the heavy, lower cost fuel oils. This using of lower priced, more viscous fuel is not a new idea to most operators and to burn it under conditions as we know them today means more maintenance and even a lower kw. hr. output per gal. in some instances. But the ultimate goal of the plant operator who is interested in the economics of the situation is to obtain a low total cost kw.hr. on the switchboard.

From a study of Table IV of costs, it will be noted that the maintenance cost per kw.hr. of the diesel plant is in tenths of a mill per kw.hr. while fuel cost is in mills per kw.hr. Also note that the total maintenance cost was $15,673 for 1948, while the fuel was $200,567. For the 25,688,670 kw.hr. generated the fuel purchased was 2,153,105 gal. Suppose that just *one* cent per gal. was to be spent to obtain a more desirable fuel oil from a maintenance standpoint. This would cost an additional $21,531.05 or $5,458 more than the total cost of engine maintenance.

Maintenance costs are undoubtedly important in plant operation and must be watched closely, but from a cost per kw.hr. at the switchboard basis, the fuel price is of far greater significance. There is definite need for more thought to be given by operators and more especially by manufacturers to the use of lower grade, lower cost fuels in large diesel engine plants for power generation.

AERA Annual Convention

The annual convention of the Automotive Rebuilders Association will be held in the Hotel Sherman, Chicago, May 7, 8 and 9. The association has completed arrangements for the three-day program which promises to be of interest to those engaged in operation and maintenance of automotive engines.

The program, as announced in the AERA Bulletin No. 125, recently released, gives the following subjects and speakers:

"Let's Face the Facts" by C. C. Tapscott, McQuay-Norris Mfg. Co.

"Engine Cleaning" by J. C. Rogers, John Rogers Co.

"Magnafluxing" by E. W. Thomas, Magnaflux Corp.

"Home-Type Run-In Equipment" by H. Torgis, A. L. Torgis & Son.

"Sleeve Installation" symposium with George Yount, Eagle Machane Co. as moderator.

In addition to the above subjects and speakers, arrangements have also been completed for a panel on Diesel Engine Service and other topics which cover the several problems encountered by the engine rebuilder and maintenance shop.

In the past, the papers presented at the conventions have been very interesting to persons in the field and have included a great deal of good, down-to-earth material which is helpful to those concerned with maintenance and repair problems. The papers listed in the bulletin give every indication of maintaining this high level of interest.

The AERA recently circulated its members to determine how many of them are engaged in maintaining and repairing diesel engines. While the number has not been released to date, the emphasis on diesel repair, as illustrated by the program for this year's convention, indicates that a large number of the association members are engaged in this work.

As further evidence of the importance of the association, a list of 57 manufacturers who have reserved booth space at the convention is also included in the bulletin. Many of these firms are engaged in diesel parts manufacture. It is expected that several additional manufacturers will be represented at the convention.

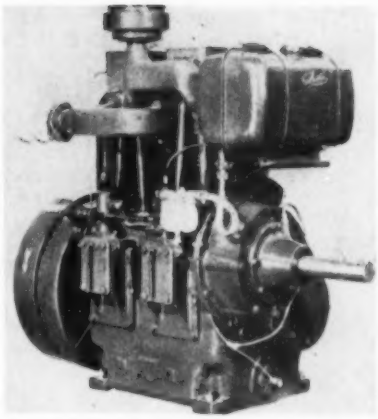
Among the firms who have already reserved booth space are Cleveland Graphite Bronze Co., Federal Mogul, Johnson Bronze, Koppers Co., Link Belt, Magnaflux Corp., Ohio Piston Co., Perfect Circle Corp., Superior Piston Ring Co., Thompson Products, Van Norman Co., Wilkening Mfg. Co., and the McCord Corporation.

Reservations, both for booth space and for the convention itself, can be made through:

Automotive Engines Rebuilders Ass'n 419 N. Capitol Avenue
Indianapolis 4, Indiana.

Advance credentials can be obtained by writing to the association at the above address. Registration costs are $12.00 per person for complete registration and $5.00 per person for program sessions only. When writing to the association, specify whether you want reservations, specifying arrival time.

Petter Air-Cooled Engines



ABOE, Inc. has now added an air-cooled version of the Petter AV water-cooled engine to their range of small diesels.

This new development is known as the AVA, and is available in either a single or two-cylinder unit developing 5.25 and 10.5 hp. continuous at 1800 rpm., respectively. The bore and stroke is identical to the water-cooled model: 3.15 x 4.33 in. The weight of the single engine is 390 lbs., while the two-cylinder engine weighs 550 lbs.

The design embodies a number of new features. Full pressure lubrication provided by a reciprocating pump is supplied to all main and con rod bearings. In addition, the rocker gear is force-fed lubricated. The main and large-end bearings are the thin-shell precision steel-backed type lined with white metal except for the upper half of the large end which is copper-lead to withstand the increased loading.

The piston is of aluminum alloy and is fitted with three compression rings, the top one being chromium plated. For lubricating oil control a slotted scraper ring is fitted to the bottom of the piston skirt. The wrist pin is fully floating. A hemispherical combustion bowl is incorporated in the piston crown. The cylinder barrel is a one piece centrifugal casting of special C. I. alloy and is heavily finned to provide for adequate cooling.

Low fuel consumption and easy starting characteristics are attributed to the use of a direct injection combustion system. Individual fuel injection pumps operated by a common camshaft provide fuel under high pressure to a closed type of multi-hole nozzle.

One of the problems that, until now, had confronted the designer of air-cooled diesels was the lack of adequate cooling of the injector nozzle. This problem has been solved by inserting an aluminum fin sheath between the head and nozzle body.

The governor is a flyball type housed in the camshaft timing gear. Control is kept within 5 per cent permanent when there is a sudden change in load. A variable speed type control is available where the application requires it.

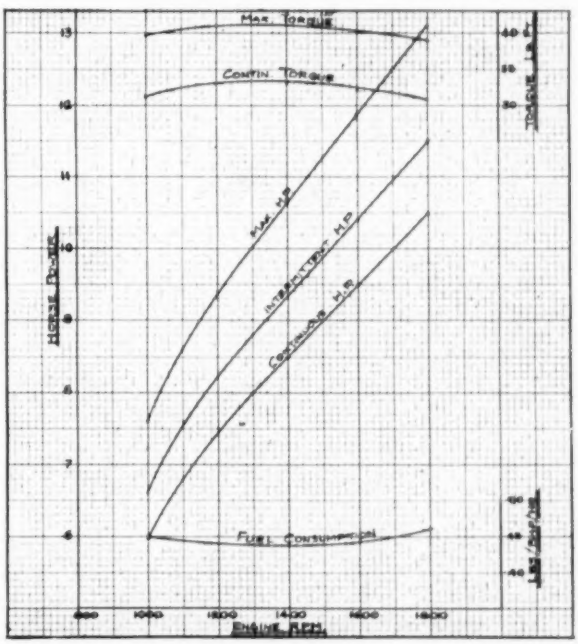
The crankshaft is a 50/60 ton heat-treated alloy-steel forging with throws at 180° apart. Carefully designed balance weights and attention to removal of excess reciprocating weight has resulted in a single and two-cylinder diesel being surprisingly free from vibration troubles.

Cooling air is provided by a centrifugal fan that is cast integral with the flywheel. The design of the air ducting causes uniform distribution of cooling air to both cylinders. In addition, deflectors are provided to direct the air where needed most. The ducting is detachable for inspection purposes.

One of the most interesting features about these two new engines is that a large proportion of the parts are interchangeable with those of the water-cooled AV models. The running gear, fuel injection equipment, camshaft and drive, crankcase, etc. are a few of the major parts that are identical. The power take-off and mounting arrangements are similar in every respect. The air-cooled engines retain the half-speed drive feature. In addition, the 1.62:1 overdrive gear is available for providing higher speeds necessary for centrifugal pumps.

Among the accessories available with the air-cooled engines is a multi-plate clutch that can be mounted either on the full-speed or half-speed power take-off. Auto-Lite electric starting likewise is available as optional equipment.

The advantages of air cooling are countless as has been proven in the small gasoline engine field. Now with the advent of diesel as an air-cooled unit the scope of applications open to this type of power has widened considerably. Generators, pumps, refrigeration units, marine auxiliaries and concrete mixers are but a few of the many fields where the diesel can be put to use.



Performance curves for for the AVA 2. The engine, which is also available in a single-cylinder model is shown above.

Diesel Parts Stockbook System

Parts are going to be tight and delivery time longer. In essential industry it is vital to have the necessary parts to keep going, but excessive stocks not only cost money but rob the other fellow. Here is a simple, effective method of stock control designed for the railroads, but the principle is applicable to all diesel using agencies.

MANY problems confronting railroad diesel storekeepers have been erased by a new combination visible stock record system and a foolproof parts ordering formula both included on a set of cards.

This system was developed by Electro-Motive Division of General Motors Corporation to keep their railroad customers supplied with up-to-date parts information. It also supplies a simple order-point formula which permits better timing of parts orders and makes it possible to put railroad inventories of parts on an actual usage basis.

Complete sets of record cards with full parts information are supplied by EMD at no cost to the customer. Whenever changes occur at the factory, revised cards are automatically sent out. The Division does all the work in keeping these records perpetually up to date.

One of the first railroads to install this new system reports a 50 per cent improvement in clerical efficiency. The chief storekeeper states that it cuts clerical time, reduces record costs, levels off stock overages and costly shortages. It enables him to see the real stock position at a glance.

The cards supplied for this system are standardized in size. They measure 10 in. wide by 6 in. deep. Each accommodates a five-year part record. Cards are die cut with the part label tabs staggered for maximum visibility. They fit into a standard Acme steel trays and cabinets as shown in the photo. Trays hold 126 cards and are removable for ease of reviewing, checking, ordering or other clerical operation where it is an advantage to take the card tray to the job.

Reference to the card shows the complete part number, description, application and interchangeability data.

ELECTRO-MOTIVE DIVISION GMC VISIBLE STOCK BOOK SYSTEM

YEAR	MONTHLY USAGE																								AVERAGE MONTHLY USAGE
	JAN		FEB		MAR		APRIL		MAY		JUNE		JULY		AUG		SEPT		OCT		NOV		DEC		
	ACTUAL	AVERAGE	ACTUAL	AVERAGE	ACTUAL	AVERAGE	ACTUAL	AVERAGE	ACTUAL	AVERAGE	ACTUAL	AVERAGE	ACTUAL	AVERAGE	ACTUAL	AVERAGE	ACTUAL	AVERAGE	ACTUAL	AVERAGE	ACTUAL	AVERAGE	ACTUAL	AVERAGE	

DATE	ORDERED				USED			BALANCE		REMARKS
	ORDER NUMBER	QUANTITY ORDERED	QUANTITY RECEIVED	BALANCE ON ORDER	FOR	REQUISITION NUMBER	QUANTITY	QUANTITY ON HAND	QUANTITY ON HAND AND ON ORDER	

CLASS

PRICE

ORDER FROM

LOCATION — RACK SECTION BIN

MAX ORDER POINT MIN. LEAD TIME QTY.

DESCRIPTION Fr. & Int. Lower Main Bearing Shell

APPLICATION All Series 567 Engines CAT OR DO. 326

REPLACES 8064547, 8072672, 8060789, 8042463 and 8028570

PART NO. 8 077 811 NAME Bearing U M 1 1 PKG QTY.

Above—Data shown on the face of the card and, below, the column headings on the back.

MAX. ORDER POINT MIN. LEAD TIME QTY.

DATE	ORDERED				USED			BALANCE		REMARKS
	ORDER NUMBER	QUANTITY ORDERED	QUANTITY RECEIVED	BALANCE ON ORDER	FOR	REQUISITION NUMBER	QUANTITY	QUANTITY ON HAND	QUANTITY ON HAND AND ON ORDER	

It permits the railroad to record monthly usage of each item. Columns for date, order, number, quantity ordered, quantity received, balance on order, order point, minimum number required per month and the lead time necessary for prompt delivery are on the cards.

How the System Works

The order formula incorporated in the card system is very simple to operate. It is based on 30, 45, 60 or on any number of days as elected by the railroad. Reference to the railroad's record tells the number of pieces actually needed per day. Multiply this number of pieces by the number of days inventory established and we find the maximum quantity needed for the period.

The minimum quantity figure must be determined and filled in on the card. This will, of course, be an arbitrary figure based on the best possible delivery time for emergency delivery—for example, three days to El Paso, Texas from La Grange. The railroad must establish this figure. Next, the stockkeeper must determine the "delivery time" or "lead time" quantity to cover the normal average time from "order date" to "received date".

To determine the "lead time" figure you simply multiply the number of pieces used per day by the number of days between ordering and delivery time. The order point on the card is determined by adding the "lead-time" quantity to the established "minimum quantity". The signal to order" is when the "on hand and on order" column equals or is less than the figure in the order space.

Compactly filed in the steel trays of the cabinets, the cards, when properly maintained, greatly simplify the complicated job of having the right part on hand at the right time.

The system goes still further. It determines the exact number of pieces to order. You merely add the difference between the "on hand" quantity and the "maximum" to the "lead time" quantity. When the "on hand" quantity is equal to or less than the "minimum" expediting is necessary.

The system recommends the use of colored metal tabs as a flag for specific action by the storekeepers. Action necessary is seen at a glance. These tabs can be seen attached to cards in the file photo.

With continual personnel changes on the railroads, the system offers a uniform pattern for posting and ordering procedure. Ordering can be done direct from cards without the necessity of taking a time-consuming physical inventory.

Electro-Motive in addition to supplying the cards also has their representatives assist their railroads in the installation of the system. Today about 13 leading roads are operating their diesel parts warehouses with this modern stockbook system.

Solving the Manpower Shortage Problem

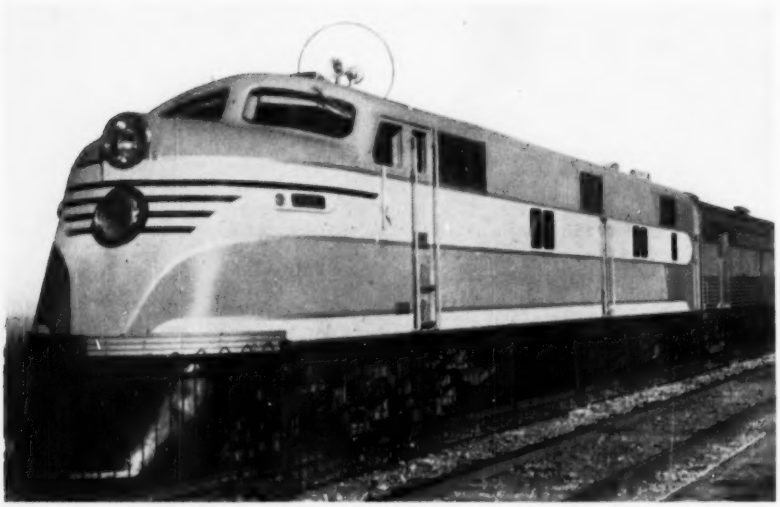
Once again industrial production management is faced with the prospect of increased demand on its productivity with the co-prospect of losing much of its man power to the Armed Services. More work and fewer hands to do the work is not a bright outlook, at the very best.

Automatically controlled operations relieves man power for other work. An automatically controlled engine not only reduces the man-hour requirement for the installation as much as 75 per cent--it makes possible the use of internal combustion engines where heretofore it has been impractical for many reasons.

Modern dependable engine control systems are designed to start and stop the engine on demand, and also to protect it against damage while starting and running. They incorporate overall limited cranking periods, with cycles of cranking and rest to give the best possible chance for the engine to start and also protect the starting system and battery from damage due to excessive cranking.

While the engine is running, the controls stand guard over it, and shut it down before any damage can be done due to low oil pressure, overheating of the cooling water, excessive speed, etc. Should the engine fail to start in the time allowed, or be shut down due to an abnormal condition, a definite signal will be given to summon the operator and will indicate the exact cause of the trouble so he can correct it immediately. In the case of multiple engine plants, a stand-by engine will immediately be started to replace the engine that failed so that no loss of service, sometimes costly or disastrous, will be encountered.

Air Horns for Diesel Locomotives



Diesel locomotive equipped with Leslie air horn (circle). This is a single tone horn, the multiple-tone horn, is shown on the opposite page.

WITH AN increasing number of diesel locomotives in operation on the railroads of this country and Canada, greater emphasis is being placed on their maintenance. This magazine is primarily concerned with the maintenance of the diesel engine but other parts of the locomotive are of equal importance maintenance-wise. In the past, we have devoted a good deal of space to problems involving electrical equipment, fire control, fuel and lube problems and other matters and, this month, we're getting to the top of the locomotive by looking at air horns with particular emphasis on maintenance and repair.

We became interested in the subject of air horns and their maintenance after reading a good many editorials and articles in the newspapers and magazines which bemoaned the "passing of the dear old Iron Horse." These stories laid particular emphasis on the wonderful sound made by the old steam locomotive whistle as it traveled across the country late at night and compared this sound with the "offensive" noises made by the new diesels.

The fact that the new horns were one of the major factors in reducing grade crossing accidents evidently had no bearing on the subject. The whole idea was that horns should have a pleasing tone whether or not they served as an effective warning signal at grade crossings, etc.

Despite all the articles and speeches concerning the "regrettable" fact that the steam locomotive was on its way out, the diesel has continued to replace this inefficient form of power. Along with the diesel has come the air horn with its increased effectiveness. Because practically all diesels have these air horns, they are important to the mechanic and maintenance man just as every other part of the locomotive is important.

A brief description of air horns will serve as a basis for a discussion of maintenance practices which will follow. In order to get material for a description of these air horns, we dropped over to the Leslie Co., one of the chief manufacturers of diesel locomotive air horns. The firm has been in this business for quite some time and is continually improving and redesigning their product for better performance, lower maintenance costs, and increased effectiveness.

A diesel locomotive air horn operates on the same principal as a saxaphone or other reed instrument. A reed or diaphragm is caused to vibrate by air pressure against it. The vibrations are transmitted into the air as sound waves of certain frequencies. The frequency is the number of complete waves transmitted per second. A low note will have a low frequency and a high note will have a high frequency.

Some frequencies are pleasant to the ear, while others are objectionable. Thus, the steam locomotive whistle was pleasant while the air horn is classed as somewhat unpleasant or objectionable and is resented.

The important fact to consider about this last statement, especially in regard to locomotive horns, is that the unpleasant sound causes an immediate reaction on the part of the listener. It is for this reason that grade crossing accidents, per million locomotive miles, have been reduced in recent years since diesel locomotives have been in use. People pay attention to the diesel horn while they are inclined to ignore the locomotive whistle. A Chime-Tone air horn which incorporates the penetrating and safety features of the single-tone horn of the diesel road locomotive and the melodious tone of the steam whistle is available to meet public demand. Existing single-tone horns can be readily converted to chime-tone in the field.

The Leslie-Tyfon air horn, made by the Leslie Co. creates a noise by virtue of the vibrating diaphragm at one end of the horn. Air pressure (taken from the air brake system) is released against the diaphragm causing it to vibrate and thus create pressure, or sound, waves. The diaphragm and the length of the horn control the note produced. It is up to the individual purchaser to decide what sound he prefers.

The diaphragm presently used is made of plastic. This one-piece diaphragm is replacing one made of laminated bronze which was used successfully for some years. It is being

replaced because the plastic offers advantages in reduced maintenance and other ways. The plastic diaphragm is currently supplemented by one made of rubber faced plastic which will permit the engineer to modulate the tone of the horn to obtain a more pleasant effect, especially when passing through town late at night. He will still be able to obtain the familiar blast if necessary.

The horn itself is made of cast aluminum alloy. Aluminum is used because it combines light weight, high strength and resistance to corrosion. All these factors are important in railroad operation and it is self-evident that these qualities contribute to reduced maintenance.

The rest of the system is made up of some tubing, a control valve and a strainer. The tubing carries the air from the air supply to the diaphragm. The valve admits the air to the horn and the strainer removes any particles, foreign matter, etc.

In order to successfully maintain the air horns, it is very important to have the cooperation of the locomotive engineer. He will notice any faults in the operation of the horn and, if he will report these faults to the mechanic or foreman when he turns his locomotive over to the shop for routine inspection or maintenance, it will make the work of the mechanic easier.

At periodic intervals, preferably at the time of annual overhaul, the air horn should be thoroughly inspected. Maintenance of these horns is a simple matter since there is only one "moving" part, the diaphragm.

To inspect and clean the diaphragm, first remove the cotter pin from the lock bolt and loosen, but do not remove, the bolt. Blow the horn at reduced pressure and unscrew the back cover until it is loose, then cut off the air and unscrew the cover plate. The horn is blown before taking off the cover plate because the air causes the cover to vibrate and thus loosen itself without the use of a wrench.

With the back cover plate removed, remove the diaphragm. If it is a plastic type, it is only necessary to clean and wipe it and inspect it for defects. If it is a metal type, it is necessary to wipe all three leaves and inspect them for dents or other imperfections.

The next step is to wash the threads of the back cover and diaphragm housing with kerosene to remove any dirt, etc. With the threads washed, apply graphite and oil to the threads and screw the back cover in all the way by hand to determine if the threads are free. It is also necessary to inspect the nozzle for dents or high spots. If these are found, use fine emery cloth with a face plate to lap in the nozzle. Another point to check while the nozzle is disassembled is the drain hole located at the bottom of the back of the horn. This must be open to allow any moisture to drain out of the horn.

You now have checked the diaphragm, threads, nozzle and drain hole. Give a quick check to the bolts holding the air horn assembly to the locomotive to see that they are tight (they can vibrate loose) and check all connections to the horn. The valve will not need attention unless the engineer has reported trouble with the horn which you can't trace to any other source.

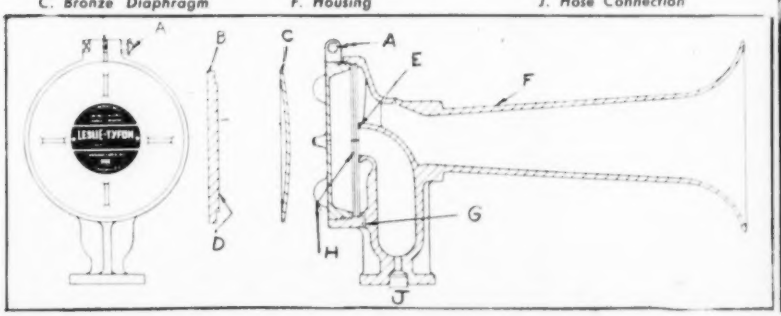
Assemble the horn by replacing the diaphragm first. If it is a plastic type, the side with a step or the rubber face should be against the nozzle (toward the front of the horn). If a bronze diaphragm is used, make certain that the three leaves have the high side against the nozzle. With this type, put the leaf showing the least wear against the nozzle for best results.

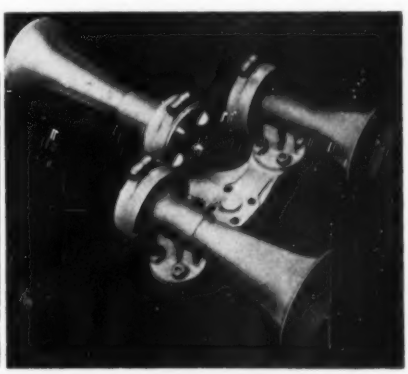
Next, screw in the back cover until it contacts the diaphragm. This will only require hand tightening. After the cover is replaced, blow the horn and adjust the cover to obtain the proper sound. As soon as the horn produces the proper note, tighten the lock bolt.

After tightening the lock bolt, replace the cotter pin and again check the tone by blowing the horn. Check the tightness of the cover by trying to turn it by hand when the horn is blowing. If it won't turn, it is properly tightened. Again, remember, never use a hammer on the lugs of the back cover to remove or adjust it. It will always move easily by hand *while the horn is blowing*, provided the lock nut has been loosened.

Well, that's it. A quick review will show you that there is practically nothing to do to maintain these horns. Periodic checks will insure their proper operation and the diaphragms should be replaced when it is necessary. Simple precautions with the threads (oil and graphite), drain hole (cleaned), diaphragm (properly inserted), lock nut (tightened and cotter pin inserted), hold down bolts (tightened) and tubing (connections tight) will practically guarantee trouble-free performance between overhauls. It is this kind of routine, preventive maintenance, which keeps all parts of equipment in operation and gets maximum performance and life from your equipment.

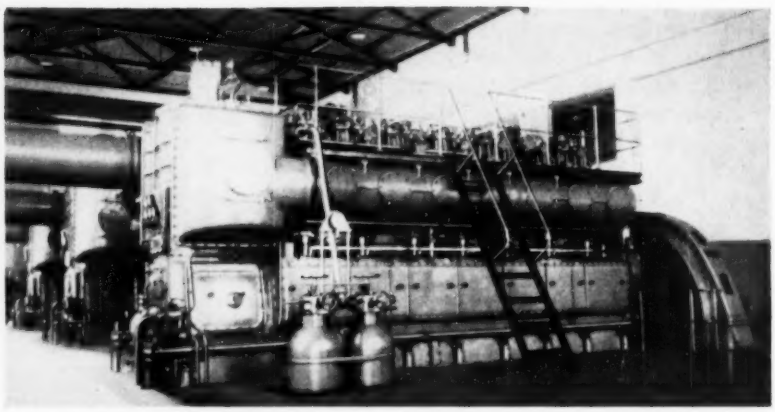
A. Lock Bolt
B. Plastic Diaphragm
C. Bronze Diaphragm
D. Plastic Step
E. Nozzle
F. Housing
G. Drain Port
H. Diaphragm
J. Hose Connection





Two Sulzer Plants in South America

Cali, Colombia



Three 7-cyl. 2-cycle Sulzer engines each developing 2400 hp. at 257 rpm. in the new power station at Cali, Colombia. A fourth engine of the same output has since been installed.

THE new power station of the Empresas Municipales of Cali, Colombia, which is to be known as the Joaquin Borrero Sinisterra Station in honor of the initiator of the scheme, was put into service in 1948. Power equipment consists of four 7-cyl. Sulzer 2-cycle engines of trunk-piston design, each of which develops 2400 bhp. at 257 rpm.

Each engine is coupled to a 3-phase flywheel type generator supplied by the Ateliers de Construction Oerlikon. Transformers are installed to bring the 2400 volts at which the generators operate up to the 13,200 volts of the distribution mains.

All four engines are run on fairly heavy fuel oil and are equipped with exhaust-gas preheaters for the fuel. The cooling water from the engines is re-cooled in open spray ponds. Sulzer Brothers also supplied all the auxiliary equipment for this power station, such as the cooling-water pumps, the fuel preheaters and the fuel transfer pumps.

The new diesel-electric power station operates in parallel with a number of existing hydro-electric stations in the immediate proximity of Cali, and with the old diesel station, in which an engine of other manufacture is installed. Space had been provided in the new station for a fourth diesel set identical to the others that has since been installed.

The opening of the new diesel power station of the Empresas Municipales was an event of considerable importance for Cali, a rapidly expanding town with a population of about 200,000. The community lies at an altitude of over 3000 ft. above sea level in the fertile Valle del Cauca.

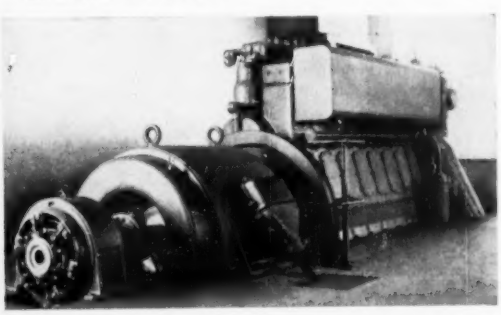
"Francois", Peru

The Cie. des Mines de Huaron S. A. works a mine in Peru at an altitude of 14,885 ft. above sea level. Known by the name of "François", the mine yields principally lead ore, with smaller quantities of copper, tin, silver and zinc. It is among the largest in the country.

The company possesses two hydro-electric power plants, one at François and the other at San José, 13,780 ft. above sea level. The water turbines, which are of various makes, are for outputs of up to 500 kw. per unit, but some of them are badly out of date. During the dry season from July to September the available water quantity is already insufficient for the full operating requirements of the mine, which is continually in the process of expansion.

In order to avoid the threatened power shortage, the Cie. des Mines de Huaron S. A. decided to install a Sulzer diesel-engine set. Its primary purpose is to ensure the necessary reserve of power and to cover peak requirements. It comprises an 8-cyl. 4-cycle diesel engine of 400 bhp. at 500 rpm., which is directly coupled to an electric generator supplied by the Ateliers de Construction Oerlikon.

At left is the Francois mine in Peru where the 4-cycle Sulzer engine of 500 hp., shown below, is installed at an al itude of 14,775 ft.



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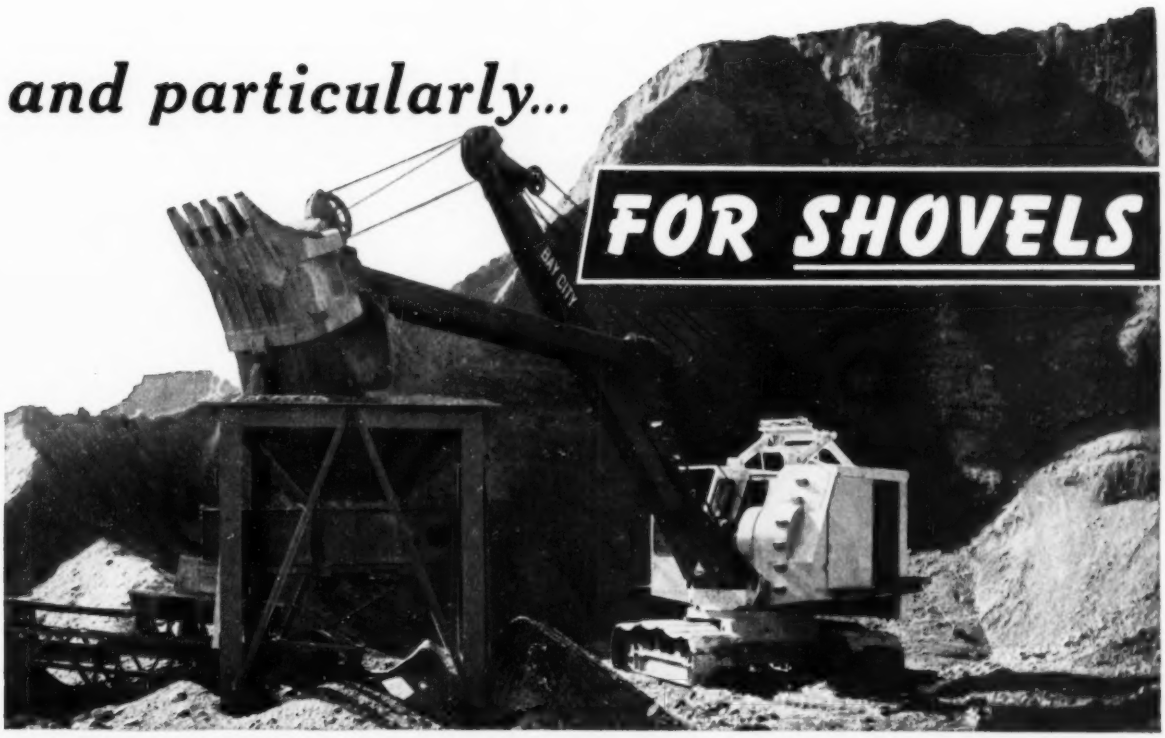
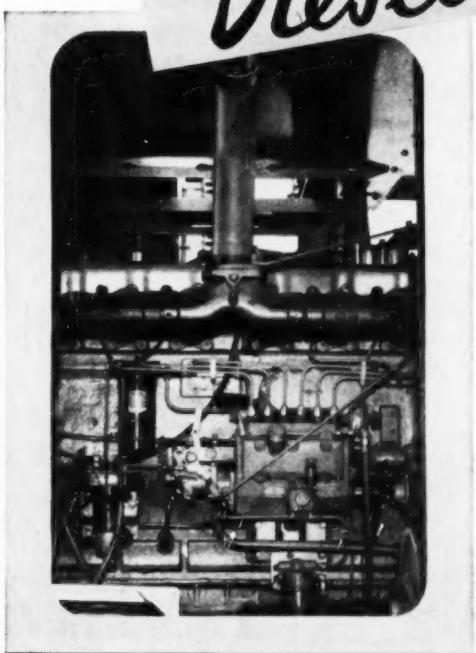


FOR SHOVELS

WAUKESHA *Diesel* POWER



● Into each shovel's life comes work that is rough and hard. And the shovel's engine has to take it, too. Putting out a lot of raw, rugged power isn't enough in itself. That power must be slick and smooth—and quick—right there the instant the operator demands it. And that's what makes Waukesha Diesels unique—their snappy fast recovery. You get more loads per minute using Waukesha Diesels.

The shovel you're watching here is working for Lyle J. Walker, a sand and gravel plant operator, at New Hudson, Mich. It's a Model 65 Bay City Shovel with a 25-ft. boom, 20-ft. dipper sticks, and a 1¼ cu. yd. dipper—powered by a Model 148-DK Waukesha Diesel, 6 cylinders, 5¼-in. bore x 6-in. stroke, 779 cu. in. displacement.

Mr. Walker operates five additional Waukesha-powered shovels—Model 45 Bay City Shovels with Model 6-SRKR Waukesha gasoline engines.

Get Waukesha Diesel details in Bulletin 1532.

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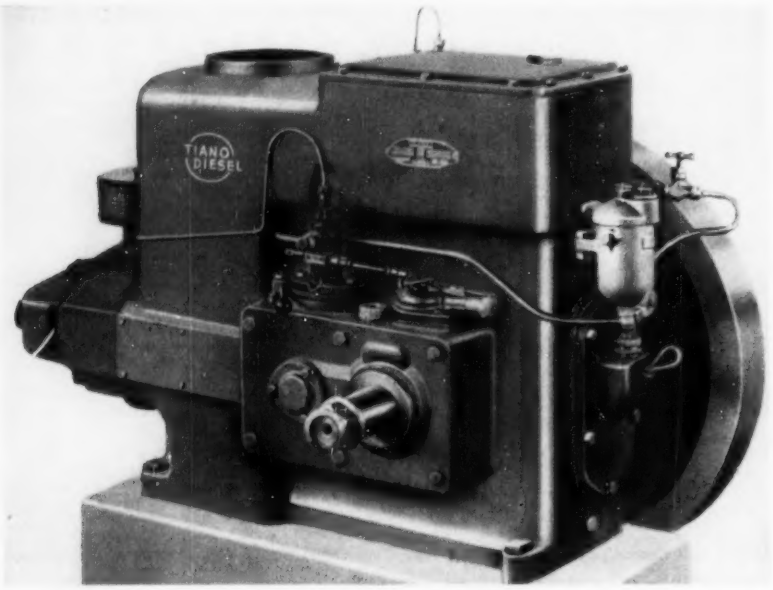
WAUKESHA MOTOR COMPANY • WAUKESHA, WISCONSIN

NEW YORK • TULSA • LOS ANGELES

New Products



French Diesel Engine

The Tiano Company of Marseille, France, has recently gone into production of a horizontal diesel engine rated 15 hp. at 1000 rpm. The design is interesting in that it employs hopper cooling, an old principle, but one involving the latent heat of vaporization after the fashion of currently much discussed high temperature cooling systems.

The totally-enclosed, monoblock construction engine has a bore and stroke of 5.13 x 6.7 in. Brake specific fuel consumption is 0.403 lbs. per bhp. hr. The 4-cycle diesel is a single cylinder design and will operate safely at a 10 per cent overload for one hour.

Other features of the engine include wet cylinder liners, aluminum alloy pistons with three compression rings and one scraper ring, forged connecting rod with phosphor-bronze bearing in the eye, and cast iron cylinder head with removable valve guides. A centrifugal governor controls engine speed. A metering helix type fuel pump delivers fuel to a pintle type nozzle that discharges the fuel into a precombustion chamber. Crankshaft bearings are pressure lubricated while other parts depend on splash for lubrication.

The engine is designed for use with generators, alternators, concrete mixers, pumps, etc.

Table Way Lubricant

A lubricant, especially developed for machine tools has been introduced by Esso Standard Oil Co. Febis K-53 is believed to fill a distinct and definite need on such tools as lathes, planners and grinders. It meets the requirements of Cincinnati Milling Machine Co. for a lubricant of this type.

An extensive program of field test work and laboratory evaluation was involved in the development of the new lubricant. The new product is a slightly tacky, non-corrosive, mild EP lubricant. It is especially designed for the lubrication of machine tool ways and for similar sliding surfaces. It is said to be superior to straight mineral oils in resisting wear on table ways and other sliding surfaces. It also has high resistance to washing from metal surfaces and has mild rust preventative characteristics.

DC Mining Motors

Net totally-enclosed, explosion-proof dc. Life-Line mining motors, either non-ventilated or fan-cooled, are available from Westinghouse Electric Corp. The motors conform to designs approved by the U. S. Bureau of Mines for use in gassy and dusty mines. They are said to be able to withstand an internal explosion, and will not ignite an explosive mixture outside the motor.

The motors are rated at from ½ to 20 hp. at a speed range of from 850 to 3000 rpm. Series, shunt or compound windings are available and voltage ratings are 230, 250, 500 and 550. All-steel construction with one-piece rolled steel frames are featured along with pre-lubricated double-sealed ball bearings. All field and armature windings are thoroughly impregnated in thermostat varnish for additional protection against conditions of extreme moisture.

Plastic Timing Discs

For certain types of time cycle control instruments, Allegheny Plastics, Inc. is producing 8-inch "Timing Disks" made of thin plastic instead of thin aluminum. It is the opinion of the manufacturer that the plastic disk is not only a readily available substitute material, but is an actual improvement over the aluminum type. The plastic disk will not crimp during handling and may be perforated on the timing track without leaving a "burr" to possibly catch as the disk revolves through its timing cycle.

Boring, Drilling and Milling Machine

Speeds from 10 to 1300 rpm. in fine increment through 45 changes provide the new single-spindle G. & L. machine with specific metal working advantages, according to the Giddings & Lewis Machine Tool Company.

Closer speed selection is said to permit maximum machining efficiency when using carbide and cast alloy tip-

ped cutting tools. Where carbides are not required, the new machine has capacity and adaptability for all types of light, medium, and heavy duty machining.

This new machine is designed to meet urgent production requirements that demand continually faster cutting speeds, heavier cuts, better finishes and greater accuracy. Six new structural features have been added to the basic machine to broaden its capacity and improve its performance. These developments plus various other improvements on standard parts and components give the new high speed machine a working range capable of solving many stubborn production problems.

Industrial Hand Pump

The Tokheim Oil Tank and Pump Co. announces the addition of three new industrial models to its line of high vacuum hand pumps. The new units, designed with safety as a prime consideration, are approved by Underwriters Laboratories, for dispensing gasoline and petroleum base products.

All three new models have bung adaptors with a vise-type screw which can be tightened on the suction stub

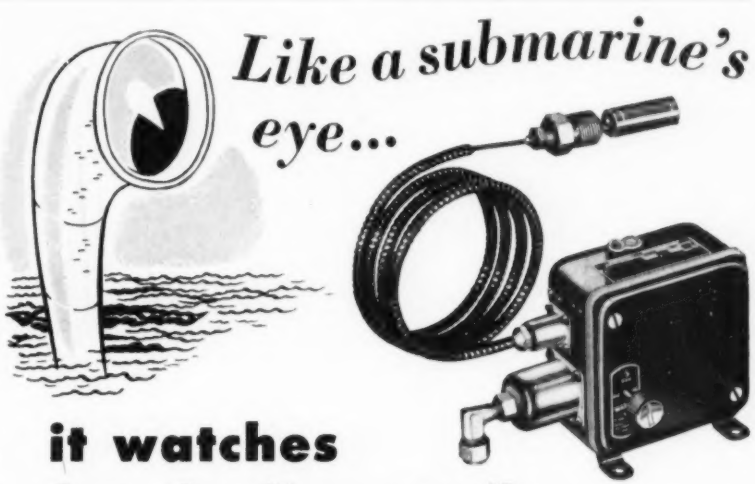
without a wrench or pliers. The suction stubs are galvanized and all metal parts which are not made of stainless steel are Permolited on the inside to eliminate rust and corrosion.

These pumps can be installed in 1½ and 2 in. bungs of drums and tanks. By replacing the drum-and-spigot method, these units eliminate wasteful dripping and slippery floors, reduce floor space required for storage, and dispense liquids practically free of sediment or condensation.

Power Package

Caterpillar Tractor Company is now marketing a power package designed for use in converting locomotive and steam-powered cranes to diesel power. Marketed with the idea of making a unit with instant availability and eliminating the many inherent maintenance and operating expenses common to steam, repowering in this field is gaining headway.

The power package consists of a Caterpillar engine of suitable rating connected to a clutch and Twin Disc torque converter. Immediately behind the torque converter, an integral chain housing is mounted for chain driving the drive shaft. The clutch, torque converter and chain housing are packaged in one assembly.



it watches for the "enemy"

Your engines have two damage-creating enemies! One is low oil pressure and the other is overheated jacket cooling water. But, both *can be detected and stopped* by the PENN Safety Control before they can cause damage and costly repairs.

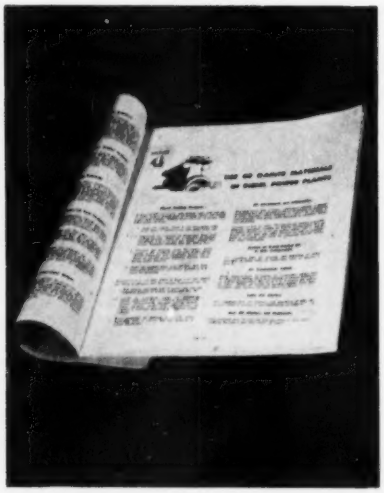
Here's how it's done. If water temperature rises to the danger point . . . or if oil pressure drops . . . the PENN control goes into action immediately! It *automatically* sounds an alarm, flashes a warning light or stops the engine operation . . . whichever you choose. Then the fault can be investigated and corrected *before* damage occurs.

Learn more about this *low-cost protection* for new or old engines. Send for your free copy of Bulletin E-100 which fully describes the three basic models for . . . oil pressure . . . water temperature . . . combination pressure and temperature. Write **Penn Electric Switch Co., Goshen, Indiana.** Export Div.: 13 E. 40th Street, New York 16, N. Y., U.S.A. In Canada: Penn Controls Limited, Toronto, Ontario.

PENN

AUTOMATIC CONTROLS

FOR HEATING, REFRIGERATION, AIR CONDITIONING, PUMPS, AIR COMPRESSORS, ENGINES, GAS RANGES



FREE BOOKLET

tells how to speed maintenance

THIS illustrated digest contains a wealth of sound, practical ideas to expedite Diesel maintenance, keep operating costs low and extend equipment life. Gives details on such subjects as:

- Cleaning filters
- Desludging lube oil coolers
- Descaling jacket water coolers
- Degreasing engine parts before repair
- Steam-detergent cleaning
- Plant maintenance cleaning

Manual also discusses tested Oakite procedures for streamlining maintenance in steam control stations and electric power plants.

FREE copy of this 16-page digest yours on request. Consult your local Oakite Technical Service Representative. Or write address below. No obligation.

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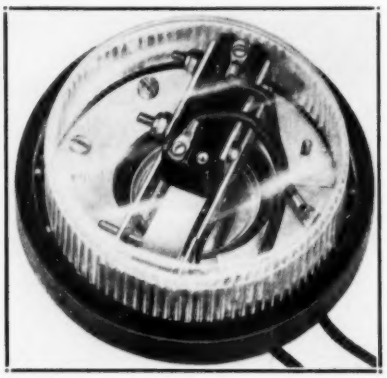
Technical Service Representatives Located in Principal Cities of United States and Canada

OAKITE
SPECIALIZED INDUSTRIAL CLEANING
MATERIALS • METHODS • SERVICE

Pressure Actuated Switch

A new low pressure actuated switch—designed to respond to the slightest change in pressure—is now being manufactured by F. W. Dwyer Manufacturing Co. According to the manufacturer, this switch is extremely accurate for indicating pressure drops in air filters, across coils, to indicate power or blower failure, actuating motors on automatic air equipment and other readings.



The slack diaphragm of this actuated switch is linked to a beryllium copper spring with a high sensitivity micro-switch which is actuated by pressure from the spring. Pressure changes are reflected in the movement of the spring and in turn the micro-switch opens or closes the circuit. The Switch is rated at 10 amperes, 110 volt ac. It is capable of operation on plus, minus or differential pressures up to 4 inches of water for standard models.

Turret Lathe

A turret lathe featuring toolroom precision is now offered by Rivett Lathe & Grinder, Inc. By adding power and speed to the basic accuracy of its cabinet lathe, Rivett has developed this 9 in. swing machine for fast production of small duplicate parts to interchangeable limits.

Well-grouped controls permit instant selection of variable cutting speeds from 90 to 3750 rpm., and a convenient automatic chuck closer with switch, controls spindle drive and brake. Spindle is dynamically balanced on super-precision, grease-

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and STUDS
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37 years' experience in making special bolts, studs, nuts for specific job requirements.

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STEEL CORPORATION
Steelwright to the Nation
REPRESENTATION IN PRINCIPAL CITIES

sealed ball bearings, mounted to incur no thermal stresses.

Newly designed collets have doubled bearing spacing for greater precision and increased gripping. Draw-in collet capacity is 1⅛ in. on long taper key-drive spindle nose. Capacity of stationary collet is ⅞ in. and closing action is accomplished without lateral movement in the spindle preventing scarring of stock. Self-alignment slide rest automatically squares itself with line of centers. Double-bevel steel ways, hardened and ground, provide positive centering action.

Automatic indexing turret revolves on ball thrust bearing with constant preload opposed by taper roller bearing preventing vertical error; the locating and locking index pin engages jig ground holes on index plate, preventing lateral error.

Pump Sequence Controller

Arising from a need by bulk station and loading rack operators in petroleum and chemical plants, a new pump sequence controller made by Fischer and Porter Co. now starts and stops pumps automatically as the flow demand changes. The control is actuated by an explosion-proof electronic circuit which senses the flow demands by means of an accurate flowmeter located directly in the main pump heater. Any number of pumps may be tied into the circuit. Flows of from ½ to 6000 gpm. may be handled.

The pump sequence controller is also available with a remote recording instrument which also provides records of pump operation.

Honing Machine

To meet the requirements of firms who desire to finish bores from ¼ to 4 in. in diameter the C. Allen Fulmer Company has brought out a new small machine with a working stroke of 15 in.

This machine carries a 1¼ in. diameter heat-treated alloy steel spindle, driven by a 3 hp. motor through alloy steel reduction gears, with three spindle speeds available. Reciprocation is hydraulic with a 2 hp. motor driving a Vickers pump with Vickers

Snap-on* Tools

help a man
get his work done
RIGHT!
Tightening a Diesel cylinder liner stud nut with Snap-on Heavy Duty Ratchet Extension and Socket.

● On the high iron, the highways and the high seas, Diesel maintenance goes faster, surer, with Snap-on *Professional* Tools. *Stands to reason!* Snap-on Tools are engineered for the tool-crib, instead of the store counter. For men to *use*, and *use hard*. They're husky where it counts most, slim and trim to reach into tight spots. Their toughness comes from *core-to-surface* tempering. They'll serve longer, cut your tool costs, cut down-time! Close-at-hand service to industry everywhere through 41 direct factory branches. Write for Snap-on Industrial Catalog and 104-page General Catalog.

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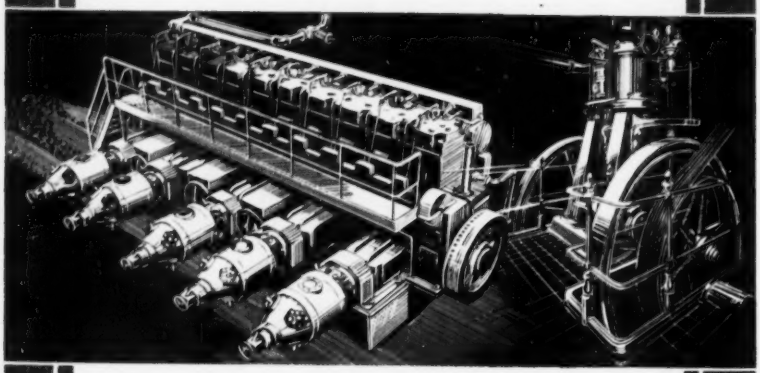
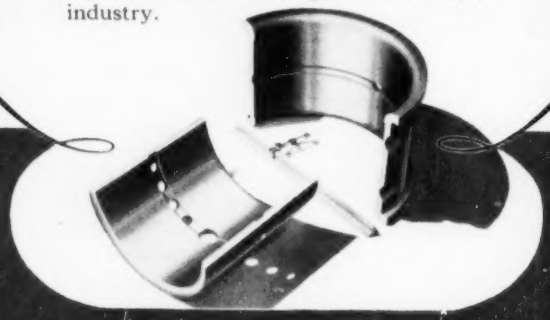
JOHNSON BEARINGS
1901-1951



Progress in Diesels Required Progress in Bearings

CLOSE cooperation on design has been carried on for years by Johnson Bronze and diesel manufacturers. The tremendous advancement in diesels since 1901 and the need for wider application of diesel power has required much research and study of sleeve bearing materials and design. Load, shock, speed, temperatures, corrosive conditions and other service considerations have been studied thoroughly by Johnson engineers. This close relationship has resulted in today's efficiency and dependability in Johnson Sleeve Bearings for the diesel industry.



SLEEVE BEARING HEADQUARTERS *Since* 1901

Johnson Bronze

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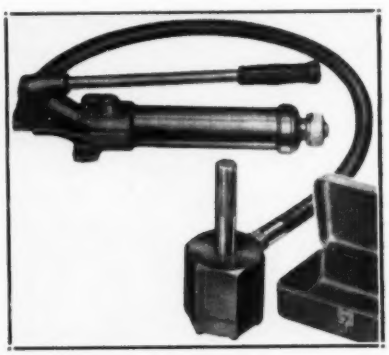
controls that permit reciprocating speeds from one to 70 fpm. The spindle and honing tools are hydraulically counter-balanced at all times.

Standard height under the spindle nose is 40 in. with different heights optional. The standard work table carries three $\frac{5}{8}$ in. Tee-L. C. Slots. For the customer who specializes in automotive cylinder honing, at a slight additional cost a special table with a built-in indexing cylinder holding fixture is available to replace the Tee-slotted work table.

A system for finishing blind holes, automatic cycling and a spindle brake are all available at a nominal added charge.

Draw Bar

Patterson Equipment Company has recently introduced a pump-operated draw bar which is said to pull $\frac{1}{2}$ to 4-in. size holes in sheet metal, switchgear housing, outlet boxes and other pieces without manual exertion or warping, breaking or tearing the metal. It is said that the danger of short-circuiting adjacent wires on



conduit box installations is eliminated.

The Ohio Draw Bar was originally designed to eliminate the use of hand operated knockout punches. However, it now finds employment for a wide variety of industrial purposes such as pulling motor bearings. Thirty pound pressure on the handle produces 12,000 lb. pressure on cutting surfaces, giving a smooth-edge hole in less than a minute, according to the firm.

Generator Sets

The Kato Engineering Company has recently announced a new range of

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NIFE NICKEL CADMIUM BATTERY

used for

Diesel Starting

Diesel Locomotives

Portable Diesels

Diesel Drill Rigs

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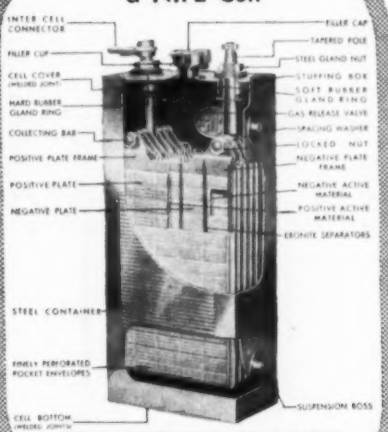
Diesel Driven Air Compressors

Automatic Diesel Plants

Section through a NIFE Cell



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Exceptionally low standing losses.

Extreme long life.

Steelbuilt—withstands shock and vibration.

Low internal resistance

No gassing during discharge

Undamaged by low temperatures.

No sulphating, shedding or buckling of plates.

Immune to excessive discharges and short circuits

For quotations and literature write Dept. 2

NIFE. THE ORIGINAL NICKEL CADMIUM BATTERY
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NIFE INCORPORATED

165 Broadway, New York 6, N.Y.

small diesel belt driven generator sets from 2½ to 10 kva.

They have adopted the Petter "AV" and "B" type diesel engines throughout. The 5 kva 115/230 volt single phase 60-cycle set is powered by a Petter AV2 two-cylinder engine which has a displacement of 67.6 cubic in. and develops 10 hp. at 1500 rpm. or 12 hp. at 1800 rpm. (continuous duty ratings).

The 2½ and 5 kva. sets can either be powered by a water-cooled or an air-cooled diesel. Power is said to be generated for as low as 1.25¢ per kwh.; this is based on a fuel price of 13¢ per gallon.

The engine can be started manually, but, if preferred, electric starting is available. Kato has provided an 18 volt dc. cranking winding as standard in their generator.

Quick Change Collet

Sutton Tool Company announces an improved master collet in which the pads can be changed without removing the collet from the machine spindle.

Holding features of the new "FL" quick change collet are the replaceable pads which are securely locked by a holding mechanism to prevent slippage from bar thrust, and are "diamond serrated" to grip work together by holding both horizontal and rotating thrusts at an angle. Available for automatic screw machines, the tool handles all sizes and shapes of stock within capacity limits. It is suggested for larger machines where tooling costs are especially heavy.

New Literature

Cooler Bulletin

A new design of oil and water cooler with several advantageous features is described in a bulletin recently published by The Griscom-Russell Co.

The unit, known as the LK-Fin Cooler uses helically-finned heat transfer elements instead of conventional bare tubes. The bulletin explains how the elements provide a lighter, more compact and less costly unit for a given cooling service, and diagrams show comparisons of length and number of tubes and size of units for equivalent heat transfer surface.

The bulletin also describes and illustrates the design details which provide most effective heat transfer, permit free expansion of the tube bundle, prevent interleakage and leakage to the outside, and promote convenience of inspection and cleaning.

Complete selection data are given for various ranges of duties, together with dimensions and specifications for standard sizes. The units are particularly adapted to services such as cooling diesel engine jacket water, lubricating oil, transformer oil and quenching oil.

Coupling Catalog

A new 4-page illustrated folder, No. 2363, on Link-Belt "RC" Roller Chain flexible shaft couplings has been published and is available from the company. Engineering information

for proper application includes dimensions, weights, service factors and horsepower ratings.

Three rather comprehensive tables are included in the folder. Table 1 covers service factors; Table 2, ratings, and Table 3 dimensions. Detailed data are also given on two types of protective grease-retaining casings.

Thermocouple Catalog

The Bristol Company has just published a new edition of its thermocouple and pyrometer accessories bulletin, listing many additional items and containing new data on the proper application and use of thermocouples. The new 56-page bulletin contains a well-illustrated catalog of hundreds of pyrometer supply items, including assembled thermocouples, thermocouple wires, extension wires, protection tubes, insulators, and accessories for the full range of industrial pyrometer applications.

New technical information and installation sketches have been added to the "Users' Manual" section, which contains engineering data on modern practices in pyrometry. Also included are tables of calibration data for the commonly-used base metal and rare metal thermocouples.

Zeolite Softener Bulletin

Cochrane Corporation has issued a new bulletin on Sodium Zeolite Water Softeners, headed "Cochrane Zeolite Softeners."

This publication gives a detailed explanation of the sodium zeolite softening process containing a definition of terms employed in this description, the data necessary for laying out a zeolite water softening plant and the factors governing the sizing of such equipment. Material on the selection of zeolite material and a description of both siliceous zeolites and non-siliceous zeolites and a description of the four steps of operation of a zeolite softener is also included.

Details of automatic operation are also covered and the bulletin is fully illustrated, not only with pictures and diagrams of the equipment in operation but with photos of actual installations.

Oil Booklet

Esso Standard Oil Company has recently made available a new booklet "Quenching and Tempering Oils". The booklet is designed to provide the background material for evolving an efficient and economical quenching system suited to the individual need.

The 11-page booklet gives a brief discussion of quenching and tempering oils and discusses such topics as heat removal during quenching, quenching mediums, mineral oil quenches, characteristics of quenching oils, quenching oil installations, maintenance of the quenching oil, and interrupted quenching. Additionally, a short discussion of tempering, tempering mediums and tempering equipment is also included.

Charts and curves giving some of the properties of various quenching mediums are included in the booklet and a short description of Esso quenching oils is also included.

Pritchard's

NEW Quintair*

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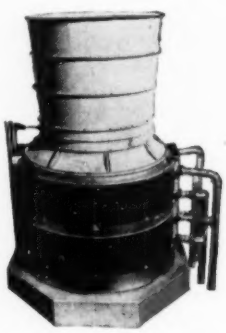

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Shovel Bulletin

Publication of a new bulletin on the Marion Type 111-M machine has been announced by Marion Power Shovel Company.

Bulletin No. 402, a two-color 12-page booklet, gives a complete design and performance story on the 111-M. This machine, equipped with diesel power, electric swing and air control, is available for service as a shovel, dragline, clamshell, crane or long range shovel. The 11-M carries a 4-cubic yard dipper as a standard shovel and a 3½ cubic yard dipper as a long range shovel. Dragline bucket capacity varies from 3 to 5 cubic yards, depending on the length of the boom.

The 111-M is designed for service in the construction, coal stripping, quarrying and mining industries.

Steel Bar Stock Bulletin

A new bulletin published by A. Milne & Co. describes a new product being supplied by the company, steel bar stock, cold drawn in special sections to fit specific purposes.

The bulletin points out that the preshaped feature eliminates many machining operations in the production of steel parts for machines and other products. In some cases, machining may be reduced to a simple cut off operation.

Drawings of some typical preshaped steel sections are shown and an indication is given of the various analyses in which this specialty stock is available.

ASME Power Cost Report

The Report on Oil and Gas Engine Power Costs for 1949 is available from the American Society of Mechanical Engineers. The report contains reliable performance and production data obtained from 102 oil generating plants, 16 plants with a total of 37 dual-fuel engines and four plants having 10 dual-fuel engines. Cost of the report is $2.50.

Information is presented in three comprehensive tables with the first showing items affecting production cost, the second giving comparative costs for plants which have submitted statistics for two or more successful years and the third providing engine details and operating information. Specific information given covers type of load; number of engines; plant hours operated; gross and net output kwh.; percentage of gross kwh. for plant purposes; cost of fuel and lube oils, attendance and superintendance, engine and plant repairs; year engine started to work; engine hours operated; engine rating; output per unit of fuel and lubricating oil consumed; engine parts renewed; number and duration of breakdown; and the personnel required.

Vibration Control Material

Featuring a step-by-step description of installation methods, a new catalog section on its recently introduced Vibropad rubber mounting has been published by The B. F. Goodrich Company.

The Vibropad is a rubber pad, 12 inches square, together with rubber tubes and snubbers from which indi-

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FORGED CRANKSHAFTS

FROM THE FORGING PRESS
THROUGH
• Careful Heat Treatment
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2. *Unusual Design Features* provide great filtering area—*combined with absorption.*
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Dirt and Dust Make W. G. B. Oil Clar-O-fication a Must!

Summing up: W. G. B. delivers the maximum in oil clar-o-fication—with an absolute minimum of service time and costs. No two ways about it—W. G. B. gives you more per dollar . . . rates first place as today's most outstanding oil filtration *buy!* Write for name of W. G. B. representative nearest you.

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W. G. B. OIL CLARIFIER, INC.
KINGSTON, NEW YORK

vidual mountings to muffle the shock, noise and vibration may be fashioned by the operators of machinery which creates these conditions. It is sold in a package which includes a booklet giving clearly written full directions on application procedures.

The catalog section pictures each of the parts for the completed rubber mounting, and includes cutaway sketches of installations on vertical and inclined machines. Photographs of typical machines on which the mountings have been used are included.

Nordberg Bulletin

Construction and operation features of the Nordberg four-cycle, one cylinder and recently introduced two-cylinder, vertical, mechanical injection type 4FS diesel engine are contained in a new bulletin published by Nordberg Manufacturing Company.

The Nordberg engines described in Bulletin 183 are built with a 4½ in. bore and 5¼ in. stroke and are available with electric or manual starting. Within an operating speed range of 1200 or 1800 rpm., the one-cylinder engine develops 10 to 15 hp. and the two-cylinder unit, 20 to 30 hp.

Petroleum Measuring Manual

A new manual, Measurement and Sampling of Petroleum and Petroleum Products, has been made available by the ASTM. The manual is priced at $2.00 in heavy paper cover and $2.65 in cloth cover.

The new manual makes available under one cover recommended methods for measuring the volume (or weight in some cases) of petroleum and its products, and for obtaining representative samples thereof. It represents the results of ten years of investigation and research by Division H on Measurement and Sampling, ASTM Committee D-2 on Petroleum Products and Lubricants.

Chain Belt Bulletin

The complete line of Rex and Baldwin Rex Oil Field Chains are described in a new bulletin available from Chain Belt Co.

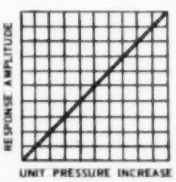
A detailed presentation of the riveted oil field assembly is given in the first part of the book. Also in-

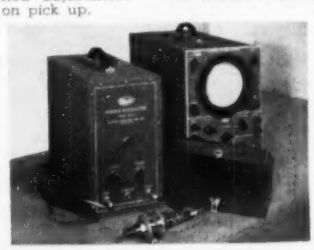
NEW
Linear Stabilized PRESSUREGRAPH
MEASURES & RECORDS EXPLOSION, GAS or HYDRAULIC PRESSURE

For Jet or Internal Combustion Engines, Compressors, Pipe Lines, Injection Pumps and Explosions

Completely Re-engineered, it now provides greater accuracy in measuring and recording pressue-time studies of dynamic, static and transient pressure phenomena. In addition to its wide range (from a few ounces to 10,000 PSI) and broad frequency response (static or zero to over 20,000 CPS) it offers these new exclusive features:

- Linear measurement
- Drift stabilized
- Temperature stabilized
- 200,000 separate pressure measurements per second
- Up to 200' of pickup cable can be used
- Greatly simplified adjustments on pick up.





DYNAMIC MICROMETER

Measures Dynamic or Static Displacement, Vibration or Movement of Any Metal Body Without Physical Contact

Only accurate measurement for static or dynamic displacement due to eccentricity, axial vibration, radial whip, bearing clearance, radial expansion with acceleration and reciprocating movement. Measurements are independent of acceleration or speed of rotation.

Electro ELECTRONIC EQUIPMENT

ELECTRO PRODUCTS LABORATORIES
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cluded is a description of oil field chains, including offset side bar roller chains and A. P. I. chains.

Roller chain couplings and sprockets are described as well as other oil field equipment, including A. P. I. oil water separators, traveling water screens, and oil field pumps.

Training Charts

The Delco-Remy Division of General Motors has released a new training chart set series consisting of 7 sections, separately bound and printed in 3 colors. A separate chart manual, containing 8½ x 11 in. reproductions of the charts and instructor's helps, accompanies each chart section. Titles and prices of the sections are:

Section A, $3.00—Fundamentals of Electricity and Magnetism."
Manual DR-5133A.

Section B, $2.00—"Storage Batteries."
Manual DR-5133C.

Section C, $3.00—"Cranking Motors & Series Parallel Switches."
Manual DR-51330.

Section D, $4.00—"The Ignition System."
Manual DR-5133D.

Section E, $3.00—"Generators."
Manual DR-5133E.

Section F, $5.00—"Standard Duty Generator Regulators."
Manual DR-5133F.

Section G, $5.00—"Heavy Duty Generator Regulators."
Manual DR-5133G.

"How to Run a Lathe"

The South Bend Lathe Works has announced the publication of the new and revised 50th edition of the book "How to Run a Lathe".

The current edition is 8 x 5¼ in. has 128 pages and over 350 illustrations. There are eleven chapters clearly written in nontechnical language, making it easy for the beginner to understand.

The text covers such items as the correct installation and leveling of the lathe, grinding cutter bits, turning, boring, thread cutting, taper turning, drilling, reaming, tapping, machinability ratings and cutting speeds for various kinds of steels; standard tolerances for press fits, running fits,

Critical Materials?

Here's one way to save

When you specify Leece-Neville heavy-duty electrical equipment, you know it will stand up and deliver under toughest conditions. Maintenance is at a minimum. That saves scarce materials . . . and manpower too.

Leece-Neville has been the leader for over forty years in the design and manufacture of special Generators, Alternators, Cranking Motors, Voltage Regulators and Switches. This equipment has set a record of performance that is unequalled.

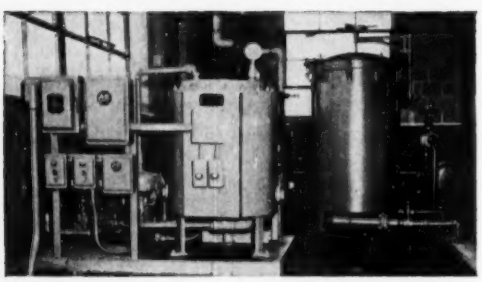
A word from you will put our Engineers to work on **your** problem. Just write Dept. 4, The Leece-Neville Company, Cleveland 14, Ohio.

Pioneer and STILL Quality Leader . . .

Leece-Neville

Hoffman I-718-18 cartridge filters provide continuous filtration of lube oil for this and other diesel engines on the Mid-Valley Pipeline. Cover-lifting device and swing-bolts speed removal of head for replacement of "throw-away" cellulose cartridges.

Lube Oil Clarity for Pump Station Diesels of Mid-Valley Pipe Line Protected by HOFFMAN Filters



Reclamation of lube oil to "like-new" standards is accomplished by Mid-Valley stations with Hoffman Model I-18-10 Vaporizers. Soluble impurities (such as light ends and water) are removed continuously by thermostatically controlled heating of the oil under high vacuum.

For the gas-diesel and straight diesel engines of Mid-Valley's pumping stations, nine Hoffman cartridge filters and three Hoffman vaporizers maintain lubricating oil with these advantages: The cartridge filters, directly connected to the engines and standby oil pumps, provide continuous purification of the lubricating oil.

Hoffman's exclusive cover lifting device and simplified swing-bolt assembly speed replacement of 7" x 18" cartridges. As an adjunct, the Hoffman Vaporizer removes solubles, at high flow rates, without the high maintenance cost of centrifuges. Write for technical bulletin.

FREE Filtration Engineering Service

For the right answer to your filtering problems, a Hoffman filtration engineer will survey your needs — make recommendations based on detailed analysis of solutions, oils and other factors. Ask for this service — there is no obligation.

FILTRATION DIVISION U.S. HOFFMAN MACHINERY CORPORATION
214 LAMSON STREET, SYRACUSE 6, N. Y.
CANADIAN PLANT: CANADIAN HOFFMAN MACHINERY CO. LTD., NEWMARKET, ONT.

push fits, and sliding fits: allowances for finishing turning, filing, polishing, grinding, reaming, lapping and honing; and tooling dimension for South Bend Lathes.

The new edition is available in paper binding at 25¢ or in imitation leather fabrikoid binding at $1.00 a copy postpaid.

Heat Exchanger Bulletin

A new bulletin illustrating and describing the line of Brown "Intergral One-Piece" fintubes has been made available by the Brown Fintube Co. The 8-page bulletin contains much information which should be useful to the plant engineer and others concerned with heat exchange equipment.

A description of the construction of the integral extended surface fintubes along with a listing of the range and sizes and materials in which they are available is contained in the publication. The bulletin also illustrates the wide variety of heating and cooling applications in which they are used and gives three pages of extremely helpful engineering data, including design curves and a tabulation showing the comparative outside surface areas provided by different sizes of bare pipe or tubing, and longitudinally finned pipe or tubing.

Cleaning Booklet

How solvent detergents provide outstanding benefits in hundreds of industrial cleaning applications is discussed in a 24-page illustrated booklet recently issued by Oakite Products, Inc.

The booklet reports upon the many classifications of cleaning in which solvent detergents are being successfully used today to perform such typical tasks as removing oily films, smuts, cutting, drawing and stamping compounds from steel in metal fabrication processes; removing carbonized oil and grease deposits encountered in the repair and maintenance of transportation facilities; to make cleaning more practical by pre-cleaning to remove extra-heavy deposits in a preliminary operation, especially applicable where metal parts are thickly coated with oils, grease and solid-

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If you have a friend or associate who you think might be interested in reading DIESEL POWER & DIESEL TRANSPORTATION, and would like to send him a free sample copy, we should be glad to cooperate with you. All you need to do is to fill in the convenient coupon while you have it in hand and drop it in the mail today. There is absolutely no cost or obligation to you. PLEASE PRINT PLAINLY.

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- One day delivery from our stock.
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- Any output of 71 engine injector available — 60 mm, 70 mm, 80 mm and 90 mm.
- An unconditional guarantee of satisfaction.

We will buy used General Motors and Caterpillar injection equipment.

Dealers write for our attractive proposition

DIESEL SERVICE DIVISION

HANCOCK MACHINE COMPANY, INC.

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particle soils; and to provide temporary rust protection to metal surfaces after cleaning.

The booklet gives specific applications of solvent detergents in metal-working plants, metal-finishing shops, and in railroad, textile and paper mill, power plant, garage, aviation and petroleum industry cleaning operations.

Diesel Bulletin

An 18 page bulletin on a new line of DR diesel engines has just been published by Worthington Pump and Machinery Corporation. The bulletin describes and pictures the four-cycle, direct injection, totally enclosed engines with photographs, cut-away line drawings and specifications. Also described are the supercharged SOR engine, the DRGO dual fuel diesel and the SDRGO supercharged dual fuel diesel.

Pinion and Gear Bulletin

A new eight-page, two color bulletin on pinions and gears for transportation equipment has been announced as available from the General Electric Company.

The publication describes the wide assortment of G-E pinions and gears for railroad, urban transit and industrial haulage equipment. The bulletin further describes, pictorially, G. E.'s manufacturing and testing facilities used for gear manufacturing, and provides a complete nationwide list of gear sales outlets, and apparatus service shops.

Tractor Catalogs

Two 16-page catalogs each telling the story of a new A-C crawler tractor have been issued by Allis-Chalmers Tractor Division. One describes the Model HD-9—weighing 18,500 lbs. and developing 70.0 drawbar hp. The other covers the Model HD-15—weighing 27,500 lbs. and developing 102.0 drawbar hp.

Each catalog utilizes double-page spreads to discuss major features of the tractors, such as unit construction, General Motors 2-cycle diesel power, the complete power train, frame and track design, simplicity of operation and ease of maintenance, including 1,000-hour lubrication.

Both make extensive use of large illustrations of the two units and their components. Captions give tractor buyers the information they want quickly and concisely. Complete specifications, plus details of allied equipment and special accessories are also included.

Instrument Bulletin

"Instant Current Measurements" is the title of a new bulletin recently issued by the Columbia Electric Manufacturing Company. The bulletin describes the several models of its tong test ammeters which are designed to measure current in conductors without breaking the circuit.

The 8-page bulletin covers such subjects as the function of the instrument, features, uses, selection methods, accuracy and other features of the instrument. It is liberally illustrated with photographs showing the various models of the instrument in use and also contains a table of standard ranges for the several models.

Field Notes

Switcher Delivered

The Davenport Locomotive Division of Davenport Besler Corp. announces delivery to the Rock Island Lines of a 110-ton, 1,000 hp. diesel electric locomotive of the 0-4-4-0 type, 56½ in. gauge, with two swivelling power trucks and two pairs of 40 in. driving wheels for each truck.

These locomotives, which are arranged for switch and transfer service are unique in that they are the first diesel electric locomotives equipped with two Caterpillar Model D-397, B-12 supercharged engines, each developing 500 hp. at 1,200 rpm.

A few of the general specifications are: wheel base rigid (truck) 8 ft.-0 in. (total) 30 ft.; length between truck centers 22 ft.; length over bumpers 41 ft.-6 in.; height above rail with center cab 14 ft.-6 in.; width over all 10 ft.; maximuin permissible speed with new wheels 60 mph.

J. F. Wilkes Honored

J. F. Wilkes, Technical Director of the Railroad Department, Dearborn Chemical Company, received the professional degree of Chemical Engineer from the University of Florida at the commencement exercises at Gainesville in February. Presentation of the degree was made to Wilkes by J. Hillis Miller, President of the University. Prior to the commencement convocation, the eight recipients of professional engineering degrees were presented by Dean Joseph Weil of the Engineering School to the guests assembled at the dedication of the new Engineering and Industries Building.

The professional degrees were awarded only to those who had made outstanding contributions in their engineering fields. In partial fulfillment of the requirements Wilkes prepared a thesis of over 165 pages on the subject: "Water Treatment for Diesel Locomotive Cooling Systems and Steam Generators."

New Bearing Firm

Bronze Bearings, Inc. has recently been organized to take over the manufacture and sale of bronze bearings, bushings, graphited oil-less bearings, and non-ferrous castings formerly produced by S & H Bearing Manufacturing Co.

President of the new firm is Mr. Sidney Hausman. Mr. Samuel P. Oppenheimer has been elected secretary and will assist Mr. Hausman in reorganization and management.

Several installations of new equipment have been added for the machine shop, and additional equipment for the foundry and added handling equipment has been installed. An additional building to increase foundry space was recently completed.

A sales force is being organized and representatives have been appointed to extend sales and service nationally, as early as possible.

Detroit Diesel Awards

Eleven sales engineers representing Detroit Diesel Engine Division distributors throughout the country have been awarded certificates of merit for outstanding accomplishments in their various fields during 1950.

The men qualified for the division's annual W. T. Crowe Diamond Award and each received a diamond ring in addition to his merit certificate.

Those honored were: William G. Wallace, L. B. Smith, Inc., Syracuse; John K. Stull, McClung-Logan Equipment Co., Baltimore; Wirt A. Branson, E. F. Craven Co., Greensboro, N. C.; Herbert F. Colby, George Engine Co., New Orleans; Lawrence C. Matousek, Western Machinery & Engine Co., St. Louis; Chris Kuehl, Fehrs Tractor & Equipment Co., Omaha; King D. Boyd, Stewart & Stevenson Services, Houston; Roy M. Carr, Colorado Builders' Supply Co., Denver; Gilmore L. Salyers, Anderson-O'Brien Co., Los Angeles; Thurston B. Perry, West Coast Engine & Equipment Co., Berkeley, Calif.; Kenneth C. Griffith, Gunderson Bros. Engineering Corp., Eugene, Oregon.

Austin-Western Sold

Baldwin-Lima-Hamilton Corporation has acquired all the outstandnig shares of Common Stock of Austin-Western Company, in exchange for 436,312 shares of Common Stock of Baldwin-Lima-Hamilton Corporation on the basis of 1.6 shares of Baldwin-Lima-Hamilton Common for each share of Austin-Western Common.

Approval by the Board of Directors of Baldwin of the proposed plan of acquisition was announced on December 14, 1950. The present offices and personnel of Austin-Western Company will remain unchanged and the present officers will continue to direct Austin-Western's operations, including manufacturing, sales and engineering. Increased demands for the products of Austin-Western Company will be met by utilizing the facilities of other Baldwin-Lima-Hamilton plants, thus allowing Austin-Western to concentrate on road graders and hydraulic cranes at its Aurora, Illinois plant.

New A-C Branch

Frank R. Hunter has been named manager of a new branch office of Allis-Chalmers' general machinery division in Wichita, Kansas.

An employee of Allis-Chalmers since 1940, Hunter has been a sales representative in the company's Kansas City district office since 1942. He is a mechanical engineering graduate of Kansas State College.

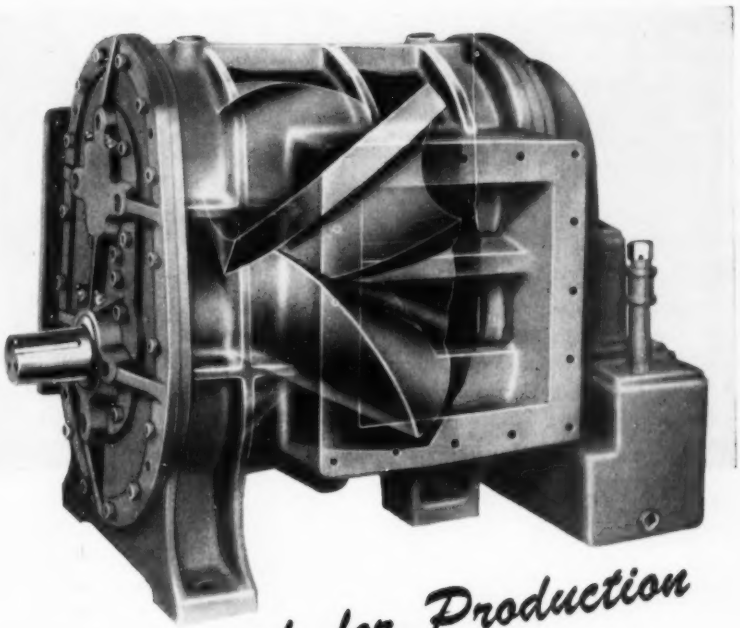
The new office is being operated as a branch of the Kansas City district office.

Mutual Chemical Plant

Mutual Chemical Company of America has announced the completion of a new chromium chemical plant to increase the production of Sodium Bichromate and other essential chromium compounds. The new plant is located on the Baltimore harbor adjoining facilities constructed previously.

With these additional facilities at Baltimore, Mutual's productive capacity is substantially increased. Operations have already commenced in the new plant and are expected to reach progressively higher levels over the next few months. The demand for chromium chemicals has been exceptionally heavy, and partly as a result of extended Soda Ash strikes in 1950, output of the industry has not been able to meet all demands. New capacity coming into production will be helpful in assuring adequate supplies of chromium chemicals.

The STANDARDAIRE *Axial Flow* BLOWER ~



Engineered for Production

TO MEET the increasing demand for Standardaire Blowers our manufacturing facilities have progressed from custom built techniques to precision production methods for the principal components of the blower. In addition to other improvements, new manufacturing processes and equipment are now being used to generate the cycloidal form, screw type main and gate rotors on a production basis without sacrificing precision and accuracy of fit—important details in maintaining the "air screw" action feature of the Standardaire Blower.

Through this unique achievement in production engineering it is possible for Standard Stoker to offer industry a Standardaire Blower with the design features and efficiency of a custom built job at the availability of a quantity production unit.

Consult with our engineers on how the modern design Standardaire Blower can be adapted to suit your requirements. Write Dept. E46 The Standard Stoker Co., Inc., 370 Lexington Avenue, New York 17, New York.

THE STANDARD STOKER CO., INC.

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Sales Division

Deluxe Products Corporation has established a separate Oil Filter and Industrial Sales Division on its line of gasoline and diesel engine oil filters and replacement cartridges. The division will be headed by J. F. Austin of Dallas, Texas, formerly representative of the DeLuxe organization in the southwestern area. It will operate under the general supervision of R. E. Archer, DeLuxe Oil Filter Sales Manager.

Underwriters OK DD Pump

Tests of the Cummin's DD (double-disc) fuel pump were recently completed by Underwriters' representatives and approval was given by the fire insurance agency for the use of the pump with Cummins Underwriters' Approved Fire Pump Engines.

All Cummins diesels for this type of service are equipped with a heat exchanger, oil cooler, mechanical governor, instrument panel, tachometer, hour meter, 24 volt electrical equipment, cooling water pump and other special accessories as may be needed by the installation.

The DD fuel pump is 65 per cent lighter in weight and 55 per cent smaller in size than the single disc pump. Because of its size the new pump is said to facilitate installation and maintenance and further reduce the overall weight of diesels.

Steel Founders' Awards

National medal awards for outstanding leadership in the steel casting industry were announced recently by F. Kermit Donaldson, executive vice president of Steel Founders' Society of America.

Honored with presentation of the Society's top award, the Lorenz Memorial Gold Medal, was Thomas H. Shartle, president of Texas Electric Steel Casting Company, Houston, and president of the Society for the past two years. Award of the Society's Technical and Operating Medal for 1950 was made to Paul H. Stuff, chief metallurgist, Ross-Meehan Foundries, Chattanooga. G. A. Lilliequist, research director and chief metallurgist, American Steel Foundries, Chicago, received the annual Steel Foundry Facts award, for excellence of material published in the Society's technical publication.

Socony Plant

A new plant for filling and distributing liquified petroleum or "bottled" gas has been completed at South Norwalk, Conn. by Socony-Vacuum Oil Company, Inc. Business, civic and Socony-Vacuum officials and many of the Mobil-flame agent distributors in the area inspected the plant when it was put into operation.

The modern building, embodying the latest features for this type operation, will serve all Connecticut and Rhode Island, as well as Westchester, Dutchess and Putnam counties with the bottled gas, taking in the area on the East side of the Hudson River as far up as Poughkeepsie.

PUMP THESE LIQUIDS

Acids	Linseed Oil
Ammonia	Lime Water
Asphalt	Lye
Alcohol	Lubricating Oils
Brines	Milk
Benzine	Molasses
Bleaches	Naphtha
Blood	Mineral Oils
Cream	Olive Oil
Chocolate	Paints
Caustics	Paint Oils
Chemicals	Petroleum
Coal Tar	Pitch
Creosote	Plastics
Dishwater	Printing Inks
Drugs	Road Oils
Dyes	Soap Liquors
Ether	Starch
Fuel Oils	Sizing Liquids
Food Products	Soy Bean Oil
Gasoline	Syrups
Glycerin	Tar
Glue	Tomato Juice
Glucose	Turpentine
Grape Juice	Varnish
Hot Oils	Vegetable Oils
Juices	Viscose
Kerosene	Water
Lacquer	Wine
Lard	Yeast

Learn more of these outstanding facts. Send for your free copy of bulletin 2201D today.

VIKING

The Pump That Is
SO RIGHT
for
SO MANY
Pumping Jobs

The fast, self-priming . . . the positive, steady discharge . . . the adaption to thin or viscous liquids, makes the Viking pump SO RIGHT for so MANY pumping jobs.

The many sizes are built in a multitude of models and styles. Each is designed for the particular pumping job. It is built to meet your requirements, completely.

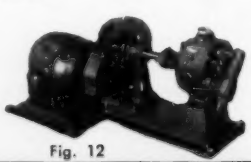
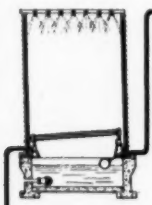


Fig. 12

VIKING
AN HONORED NAME IN PUMPING

See Our Catalog in Sweet's

Viking Pump Company
Cedar Falls, Iowa



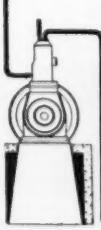
Binks closed-type

DIESEL COOLING SYSTEMS

produce higher engine efficiency

Diesel engines may be operated at higher, more efficient temperatures with Binks Type "D" evaporative heat exchange coils, installed in a Binks natural or mechanical draft cooling tower. The Binks system is a closed one in which treated or soft water can economically be used for cooling purposes. Scale formation in jackets is eliminated. Exact temperature control is obtained. Diesel "down time" is cut. Breakdown insurance rates are lower.

SEND for Bulletin 41. Obtain full information—drawings, tables—on heat exchange coils adaptable to a variety of operating conditions.



Binks MANUFACTURING COMPANY
3114-38 Carroll Avenue
Chicago 12, Illinois

REPRESENTATIVES IN ALL PRINCIPAL CITIES

ASHVE Committee Chairman

I. W. Cotton, president of the I. W. Cotton Company, Inc., was appointed chairman of the Committee on Research of the American Society of Heating and Ventilating Engineers for 1951. The Committee plans and supervises the society's research program at its laboratory in Cleveland and at cooperating colleges and universities.

Mr. Cotton is a graduate of John B. Stetson University, DeLand, Florida, and the University of Chicago. He incorporated the I. W. Cotton Co., a distributor of heating, ventilating and air conditioning equipment.

New Company Formed

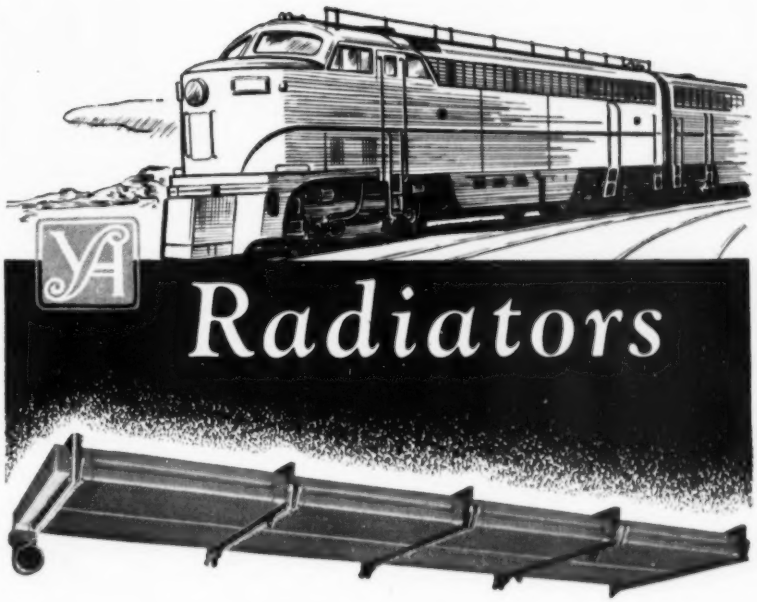
A new firm, Gunk Atlantic, Inc., has been formed to market Gunk products throughout the eastern U. S. Announcement of the new firm was made by A. F. Curran, inventor of Gunk, who is associated with the Curran Corp., Gunk manufacturers. Mr. Curran will also be associated with the new company to solve various technical problems.

The new firm will concentrate on plant operation and production and will carry out a selling and merchandising program. It is expected that this new development will result in a substantial increase in product sales.

Fram Meetings

Salesmen of automotive jobbers in the New England area received firsthand information on the Fram Corporation's 1951 merchandising program through the medium of a series of meetings held at that company's main headquarters in East Providence, Rhode Island.

The general pattern of these meetings included morning sessions devoted to informal talks by representatives of Fram's Engineering and Research Departments, as well as men from the Sales and Advertising sections. Luncheon was followed by a conducted tour of the Engineering-Research Laboratory and the company's main plant in nearby Pawtucket, Rhode Island. Jobber salesmen are in this way brought up to date on improvements in Fram's products, and manufacturing processes, and informed of current merchandising methods.



. . . right for diesel locomotives

Standard bearer of modern American railroads — the diesel locomotive is among the toughest of all radiator applications. Its space limitations, power concentration and vibration characteristics are as critical or more so than any in industry.

To lick these problems, more than half of the leading diesel locomotive manufacturers in the United States turn to Yates-American.

. . . right for your application, too

Whatever your products — trucks, tractors, compressors, power plants — you can be sure of best results with Yates-American radiators. Write today for full information.

California Representative: E. E. Richter & Son, Emeryville, California

YATES-AMERICAN MACHINE CO.
HEAT TRANSFER PRODUCTS DIVISION BELOIT, WIS., CHICAGO, ILL.

Pneumatic Purchases London Plant

The independent Pneumatic Tool Co. announces the purchase of Armstrong-Whitworth and Company, Pneumatic Tools, Ltd., Gateshead-on-Tyne, England. The Armstrong-Whitworth name will be retained.

Robert G. Faverty, former manager of Thor branches in Chicago and Detroit, has arrived in Gateshead to assume the position of managing director. The only other change in organization of the affiliate is the naming of William Scott, O. B. E., J. P., as chairman of the board. Mr. Scott is managing director of the Jarvis Industries Group, which comprises all Armstrong-Whitworth divisions.

Erection of a larger plant is planned to handle anticipated increase in production of the combined lines.

Specify
COLUMBIA
A. C. and D. C.
GENERATORS
• For Coupled Service
• For Belt Drive
• Single or Two Bearing

Columbia, with its years of experience, brings to generator set assemblers a wide line of performance proved, sturdily built, A. C. and D. C. Generators.

AC Generators: 6¼ to 1000 KVA
DC Generators and Exciters: 2 to 300 KW

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Write for information. Our Engineers will be glad to review your requirements.

COLUMBIA ELECTRIC MFG. CO.
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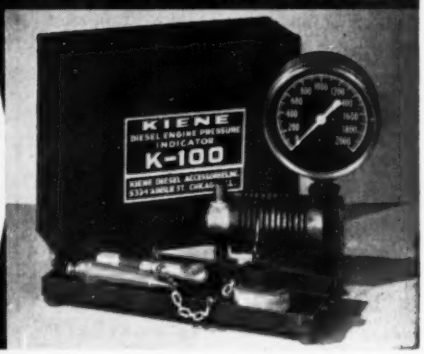
SAVE MONEY BY KNOWING WHEN TO OVERHAUL YOUR DIESELS

KIENE DIESEL INDICATOR will tell you Compression and Firing Pressures ...FAST



WHY GAMBLE?

With the KIENE DIESEL PRESSURE INDICATOR, you waste no money on costly overhauls done too soon—take no risk of putting off overhauls until too late.

The KIENE INDICATOR tells, reliably by accurate measurement of compression and firing pressures, when your engine needs attention.

SIMPLE—no complicated adjustments. RELIABLE—not affected by heat. ACCURATE—effects of friction and inertia eliminated. RUGGED—only one moving part. COMPACT—weighs less than ten pounds.

LOW IN COST—For full details, send for Bulletin K-100.

KIENE DIESEL ACCESSORIES, INC.
10352 PACIFIC AVE., FRANKLIN PARK, ILLINOIS

ABOE Press Conference

A press conference at which Alan P. Good met representatives of the press was held at the offices of ABOE, Inc. recently. Mr. Good is managing director of the Brush-ABOE Group of electrical and diesel engine manufacturing companies, London, England.

He has stopped off here in a world-wide tour of branches and affiliates of his companies, which operate in 87 countries and territories. He made the trip to check up on the reception to his companies' products, and to review performance of the various sales and service organizations.

Lamme Award

Award of the 1950 Benjamin G. Lamme gold medal by the AIEE to Donald I. Bohn, chief engineer of the Aluminum Company of America, Pittsburgh, was announced today by A. H. Kehoe, of New York, Lamme Medal committee chairman.

Mr. Bohn, a native of Chicago, won the medal "for his pioneering development and application of electrical equipment for controlling rectifying systems in the production of aluminum." He has been granted many patents in this connection and for other inventions. He was very active in the design and development of the Nordberg radial engine.

Aeroquip Buys Metalco

Aeroquip Corporation has purchased all the outstanding stock of Metalco, Inc. Metalco has been a substantial subcontractor of Aeroquip, furnishing a variety of special hose fittings, tube bends, and elbows used in the firm's hose assemblies.

Operation of the newly acquired company will be continued as a wholly owned subsidiary of Aeroquip, with Don Mortlock as vice president and general manager. Kenneth Meyerholtz, chief production engineer and plant superintendent of Aeroquip, has been elected president of Metalco. Fred Corwin, secretary of Aeroquip, is secretary-treasurer.

Fairbanks Award

Paul A. Suess, manager of Fairbanks, Morse de Mexico, S. A., was presented with the President's Cup by Robert H. Morse, Jr., president of Fairbanks, Morse & Co. The presentation was made at the Hotel del Prado in Mexico City.

Eighteen years ago Colonel Robert H. Morse, who was at that time president of the company and who is now chairman of the Board and general manager, first presented a trophy to the company's branch house which enjoyed the largest volume of sales in relation to its annual quota. Since the inception of the Cup Race, the trophy has traveled from coast to coast, having been won several times by the New York and San Francisco branches and also by branches located in Cleveland, St. Paul, St. Louis, Kansas City, Omaha and Dallas.

Nordberg Distributor

Appointment of Yaun Equipment Company of Baton Rouge, Louisiana as distributor for Nordberg 4FS diesel engines in the southern half of Louisiana was recently announced.

Yaun Equipment Company was established in 1921 by J. F. Yaun, who owned and manufactured a patented all welded steel dragline bucket. In addition, the company manufactures sugar mill equipment and maintains office and machine shop facilities for the sales and service of all equipment. Mr. J. C. Yaun is in charge of all heavy equipment sales.

The Nordberg 4FS engines, built in 1 and 2-cyl. models, range from 10 to 30 hp. at 1200 to 1800 rpm. These 40-cycle, heavy duty, vertical engines are designed for stationary or portable power applications and marine auxiliary uses, and are offered as complete, self-contained electric generator sets, centrifugal pump units and with clutch or stub shaft power take-off for direct connection or belt drive.

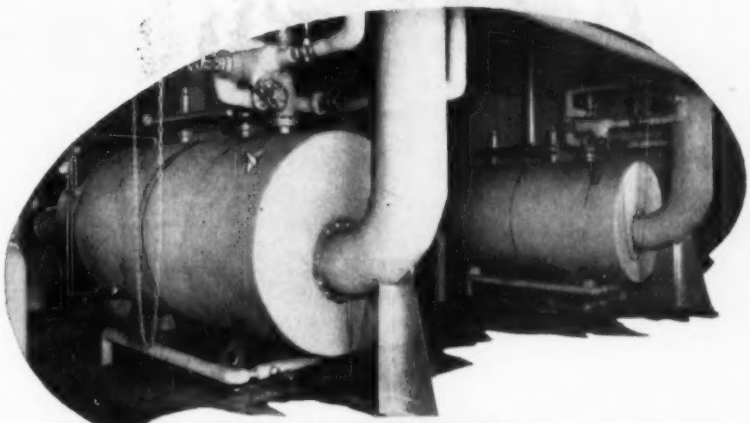
New Worthington Plant

Ground was broken at Succasunna, New Jersey recently for a vertical turbine pump plant of Worthington Pump and Machinery Corporation. This will be the corporation's 20th plant. It will manufacture vertical turbine pumps to serve customers east of the Mississippi River, as well as customers abroad.

The non-combustible one-story building will measure 80 by 200 ft. It will contain several bridge-type traveling cranes and will be used primarily for warehousing and assembly work. Small capacity machining facilities will be used at the start. There will be an engineering room at the plant, as well as a test stand for simulating field conditions to check the mechanical and hydraulic phases of the equipment prior to shipment.

Features of the plant will be a 35,000 sq. ft. macadam loading area on the north and west sides of the building. A siding will be run from the nearby Lackawanna Railroad tracks along the east side of the building. Here the box car floor will be level

IS WASTE HEAT WASTING YOUR MONEY?



MAXIM

HEAT RECOVERY SILENCERS CONVERT WASTE EXHAUST HEAT TO USABLE STEAM or HOT WATER

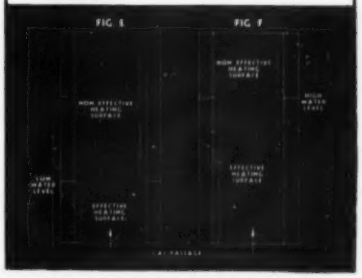
A big Los Angeles Sewage Disposal Plant found that Maxim Heat Recovery Silencers provided all the steam necessary for plant heating as well as heating the sludge — *and from exhaust heat that would otherwise have been wasted.*

Perhaps your own operating expense picture can be improved by this simple and effective way to provide extra steam or hot water for heating or processing operations while at the same time effectively silencing exhaust noise. Our engineering department will be glad to make recommendations.

Automatic Controls

In figure E water is low and there is less *effective heating surface* (heating surface in contact with water), hence lower steaming rate.

In figure F water is high and gives greater effective heating surface — higher steaming rate. Steam pressure regulated valves control the amount of water to produce desired steam capacity.



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Gentlemen: Please send me your Bulletin on Heat Recovery Silencers

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COMPANY _____

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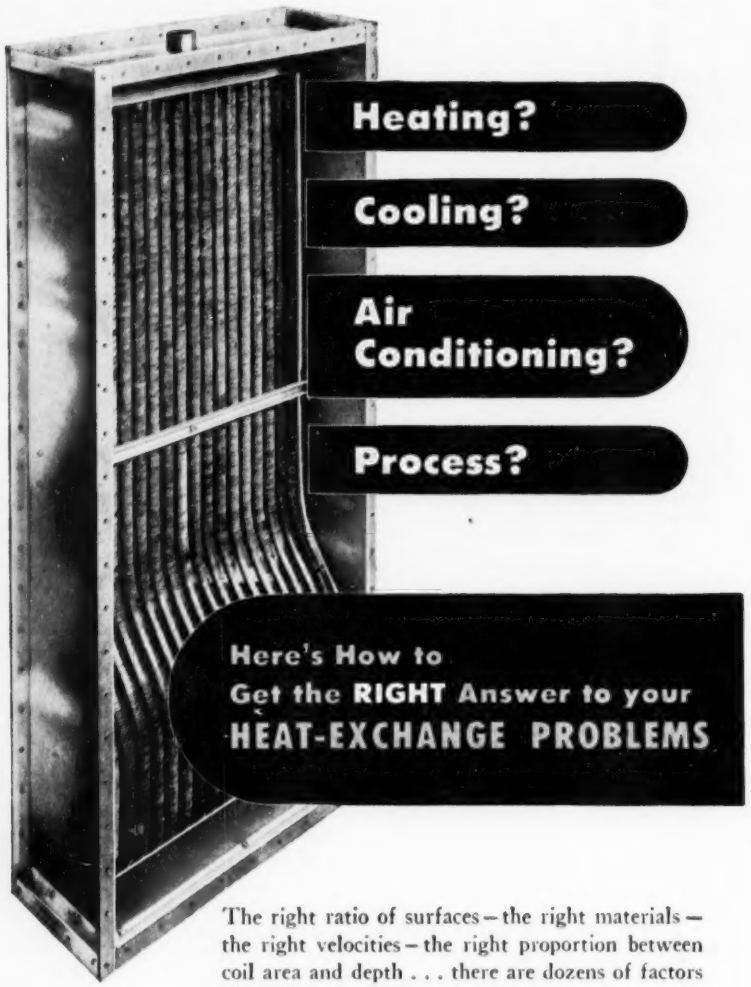
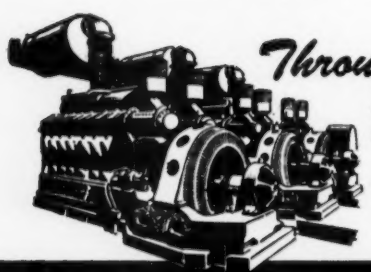


The right ratio of surfaces – the right materials – the right velocities – the right proportion between coil area and depth . . . there are dozens of factors that affect the efficiency, maintenance and service life of heat-exchange coils.

For best performance in your own application, the practical approach is to take full advantage of the unequalled engineering, research and design skill — the unequalled manufacturing and testing facilities — which Aerofin offers you.

To get the *right* answer – ask the Aerofin man.



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Aerofin is sold only by manufacturers of nationally advertised fan system apparatus. List on request.

with the plant floor. The plant is also convenient to State Highways Nos. 6 and 10.

I. C. Engine Institute Elects Officers

The Internal Combustion Engine Institute elected officers recently at its annual meeting. The institute, formed in 1933, is an association of sixteen internal combustion engine manufacturers, including producers of diesel, gasoline, and gas engines.

The newly elected officers are: W. M. Holland of International Harvester, president; G. W. Thomas of Continental Motors, vice president; J. E. Heuser of Le Roi Co., secretary; and J. F. Bachman of Ford Motor Co., treasurer.

Caterpillar Man to Munitions Board

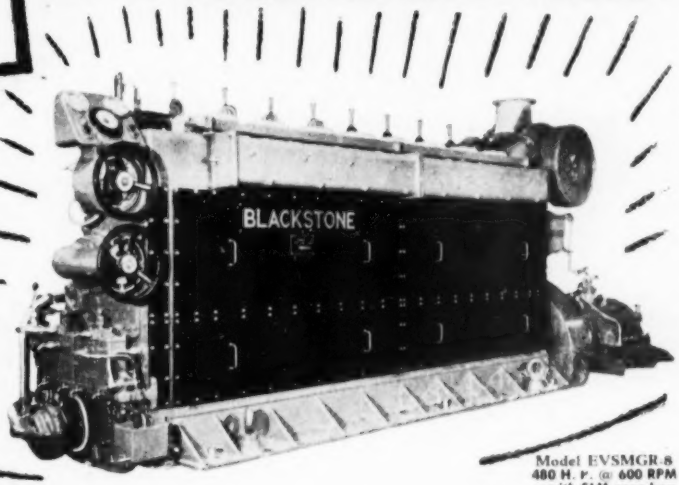
W. J. McBrian, Caterpillar vice president, has accepted the position of vice chairman of the Munitions Board, top governmental agency. His services will be lent to the government for several months, in support of the national emergency.

As vice chairman for procurement and distribution of the Munitions Board, Mr. McBrian is responsible for the administration of those matters for the military departments. Three other vice chairmen are assigned to the problems of production, stock piling of essential materials and international relationships. He will direct and coordinate the work of six important offices and agencies: the Office of Procurement, the Office of Distribution, the Office of Small Business, the Office of Price Control Policy, the Cataloging Agency, and the Standards Agency. In addition to his work with these six offices, he will recommend and review actions of the Armed Services Explosives Board.

The appointment is in furtherance of broad plans of the President and General George C. Marshall, Secretary of Defense, for reorganization and expansion of the Munitions Board, directly responsible to them through chairman John B. Small and executive vice chairman, H. K. Clark.

Lister-Blackstone Announces . . . AN ACHIEVEMENT OF —

THOROUGHBRED POWER AT A CHALLENGING PRICE!



Model EVSMGR-8
480 H. P. @ 600 RPM
with SLM gear box

Available in industrial and marine models. Three, four, five, six and eight cylinders.

Super-charging on four, six and eight cylinder models.

Marine engines have separate, oil-operated SLM gear box.

Write for information outlining your requirements.

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Factory, Sales & Service Headquarters:
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Winnipeg • Vancouver

The New 'EV' Series

145 H. P.—480 H. P.

★ Prompt Deliveries

★ Dependable, nation-wide Lister-Blackstone Service

Quaker Rubber Promotion

J. R. Lewis has been appointed assistant general sales manager of Quaker Rubber Corp., a division of H. K. Porter Company, Inc.

Mr. Lewis has been with Quaker since 1940. He has advanced steadily in the organization, having held positions as Philadelphia district sales manager and assistant sales manager.

Thor Changes

Transfers of three Independent Pneumatic Tool Company branch managers and the appointment of one new branch manager have recently been announced.

John B. Dempsey, for the past three years manager of Thor's Pittsburgh branch, has been named manager of the Detroit branch, succeeding Robert G. Faverty, who was appointed managing director of Armstrong-Whitworth and Co. Pneumatic Tools, Ltd., new Thor subsidiary in England.

Edward W. Krantz, for the past four years manager of the New York branch, has been appointed Pittsburgh manager to succeed Mr. Dempsey.

William J. McGraw, manager of the Cleveland branch for the past two years, has been appointed manager of the New York branch to succeed Mr. Krantz.

Clarence B. Bargren, service engineer, in the St. Louis territory since 1946, is the new Cleveland branch manager, succeeding Mr. McGraw.

Lister Representative

The appointment of H. J. Keizer as West Coast sales & engineering representative has been announced by Lister-Blackstone, Inc. The position is newly created and will be one working with Lister-Blackstone distributors and authorized dealers throughout the West Coast territory.

Mr. Keizer brings to his new appointment sixteen years of sea-going experience as engineering officer on diesel vessels, as well as service with Fairbanks, Morse handling marine sales in the San Francisco area and later as design engineer at the Head Office at Beloit, Wisconsin.

Headquartered in San Francisco, Mr. Keizer will travel the entire Pacific Coast from Seattle to San Diego, assisting in the selling and engineering of Lister-Blackstone installations in the marine and stationary field throughout the area.

J. R. Meek Addition

Joe C. Shaw, sales engineer with the Young Radiator Company is now affiliated with the J. R. Meek Company.

Shaw has been associated with Young since 1942 and has had extensive experience in the engineering field. He is a graduate of Purdue University, receiving a degree in Mechanical Engineering in 1931.

Fairbanks Branch

Fairbanks-Morse & Co. announces the opening of its new branch in Philadelphia, Pa., located at 401 North Broad St. Mr. Robert W. Perry has been appointed manager, with offices on the seventh floor.

The new branch will have jurisdiction over eastern Pennsylvania, southern New Jersey, Delaware and the eastern shore of Maryland.

Worthington Appointments

A manager and assistant manager of Defense Procurement have been named by Worthington Pump and Machinery Corp.

Mr. F. C. Winter, manager of stores for Worthington's Harrison Works, will also act as the corporation's manager of Defense Procurement, dividing his time between Harrison and the company's Washington office.

C. W. Camp, electrical engineer in Worthington's sales department, has been named assistant corporation manager of Defense Procurement, with headquarters at Harrison.

PROTEKTOIL

Protective Lubrication

A COMPATIBLE LUBRICATING OIL and fuel additive

PURGES gum carbon sludge and varnish

PREVENTS sticky valves and rings.

PRODUCES peak engine performance

PROLONGS motor life

THE PROTEKTOIL CORP.

601 West 26 St., New York 1, N. Y.

Rock Island Promotions

F. R. Hosack, general superintendent of motive power of the Rock Island Lines, announced recently the appointments of C. B. Camp and P. J. Biggan as master mechanics respectively of the Western and Missouri-Kansas divisions.

Mr. Camp's headquarters will be at Goodland, Kansas and Mr. Biggan will base at Armourdale, Kansas.

Sun Appointment

Frederick B. Hufnagel, Jr. has been appointed assistant to R. H. Anders, director of purchases, Sun Oil Company. His office will be in the Purchasing Department, 1608 Walnut St., Philadelphia, Pa.

Mr. Hufnagel has been relieved of his duties as assistant coordinator in the Marketing Department for the duration of the current emergency. He will devote his time to representing Sun Oil Company with government agencies in the administration of regulations controlling materials and their supply, as they affect all departments of the company.

Nordberg Appointment

Appointment of Robert P. McBride as sales engineer, Heavy Machinery Division, is announced by R. W. Bayerlein, vice president, Heavy Machinery Division, Nordberg Manufacturing Company.

In 1950 McBride came to Nordberg and worked on the diesel test and erection floor. He was assigned to field installation service prior to becoming sales engineer.

Foxboro Addition

A new branch office of the Foxboro Company has been opened at 618 W. Church Avenue, Knoxville 16, Tennessee. Mr. Marvin L. Cleaton, Jr., formerly in charge of the company's office at Columbus, Ohio, has been transferred to become Branch Manager at Knoxville. Until now, manufacturers in the Knoxville area have been served by the Foxboro office in Atlanta.

Double Seal Apointments

M. A. Moore has been promoted to the post of Eastern division manufacturing and sales manager of the Double Seal Ring Company.

Moore, who was formerly Double Seal's sales and service representative in Maine, Vermont and New Hampshire, has assumed his duties in the company's Eastern division factory and sales office, at New Rochelle, N. Y.

Fairbanks Promotions

Fairbanks, Morse & Co. announce the advancement of T. E. Woodruff from assistant manager to manager of the pump division with headquarters in Chicago. He succeeds D. T. Johnstone who assumes the duties of pump department manager of the company's San Francisco branch house.

Air Maze Appointment

Mr. John Clem has been appointed to head the sales activities of the Air Maze Corp. with headquarters at 115 Park Row, New York. He will be responsible for sales in eastern New York, Eastern Pennsylvania, Maryland, Delaware, and Washington, D. C.

Mr. Clem was formerly with Fairbanks, Morse in Beloit and Chicago.

NEW ENGLAND HEADQUARTERS FOR DIESEL ACCESSORIES

American Bosch
Bendix Scintilla
Briggs & Stratton
Delco-Remy
Stewart Warner
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There's a reason why we've grown—since 1904—to be the automotive and Diesel leaders in this busy New England area. A recognized service organization geared for fast, intelligent handling of your specialized maintenance problems.

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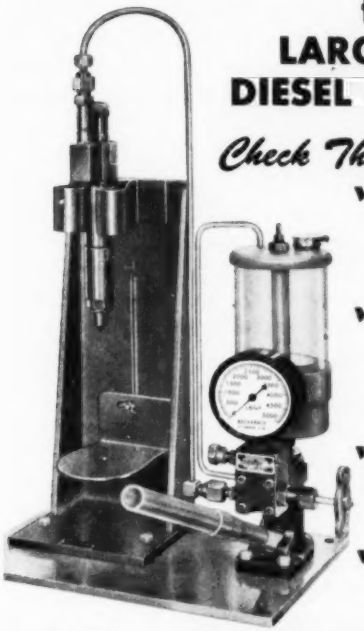
121 BROOKLINE AVENUE BOSTON, MASS.

BACHARACH NOZZLE TESTER for LARGE SIZE DIESEL NOZZLES



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- Test Pump 1800 cu/mm capacity; ported design. Leak-proof—plunger is chrome steel, hardened, ground and lapped into pump body.
- Nozzle-holding Fixture has spring clamps that accommodate nozzles of different shank diameters. Nozzle is simply "snapped" into position between the clamps.
- Fuel Supply Reservoir (2.5 pint capacity) of durable, transparent plastic; fuel level can be easily observed.
- Micronic-type Filter is noted for its superior cleaning efficiency; is easily replaceable.

Get full particulars — Write for Leaflet 628

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"FIXED-READING" PREMAX PRESSURE INDICATOR

for **DIRECT-READING** *or* **COMPRESSION** *and* **FIRING PRESSURES**
OF EVERY TYPE OF DIESEL ENGINE

ONE OF THE FEATURES Responsible for Its Overwhelming Preference by Leading Diesel Manufacturers and Operators

No mistake can be made in reading—since only one figure appears in the window of the counter—and this figure represents the actual engine pressure directly in pounds per square inch.

For other features, write for Bulletin 294

ACCURATE PRESSURE READINGS as high as 1700 P.S.I.

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INDUSTRIAL INSTRUMENT CO.
7000 BENNETT STREET • PITTSBURGH 8, PA.

Fram Changes

Fram Corporation has recently announced several promotions and transfers in its Jobber Sales Division.

Arthur A. Sherman, formerly district manager of Southeast New York, New Jersey and Northeast Pennsylvania, has been made assistant zone sales manager in the New York, Pennsylvania, New Jersey, Maryland and Delaware territory.

Vincent L. Benton, district manager of the Michigan, Wisconsin and Northern Illinois area has been promoted to assistant zone sales manager of H. J. Rowe's zone, comprising Indiana, Illinois, Wisconsin, Michigan, Minnesota, Iowa, South Dakota and North Dakota.

Charles Benton, formerly a field engineer, succeeds Arthur Sherman as district manager.

Frank W. Lescher, field engineer in South Michigan and Western Ohio, was promoted to assistant sales manager in the Jobber Division at Ohio and Michigan, headed up by Roy C. Noll.

William Stocking, who has served as field engineer in Southwestern California, has been made assistant sales manager in the Jobber Division in C. T. Woods' Pacific Coast Zone.

Hunt-Spiller Changes

Two changes in operating personnel have been announced by the Hunt-Spiller Manufacturing Corp.

Charles F. Scott has rejoined the firm as supervisior of foundry production scheduling. Mr. Scott was with the firm for 24 years, but spent the last five months with Boston Electro Steel Castings, Inc.

Mr. Wallace B. MacGregor has been named materials control supervisor of the company.

New York Central Appointments

James J. Frawley was recently appointed vice president, operations and maintenance, of the New York Central System, with headquarters at New York City. In this position, he succeeds Frank J. Jerome who was recently appointed executive vice president.

Mr. Frawley's appointment heads a series of promotions in the operating department, all effective immediately.

Richard G. May is appointed assistant to vice president of operations and maintenance, with headquarters at New York City, and is being succeeded as manager of freight transportation at New York by Harry D. Johnston, general manager of the Central's affiliated Boston & Albany Railroad at Boston.

Mr. Johnston is being succeeded by John F. Nash, superintendent of the Mohawk and Hudson divisions at Albany, N. Y. Lawrence E. Pangburn, assistant superintendent at Buffalo, N. Y., follows Mr. Nash at Albany, and is being succeeded in turn by Gregory W. Maxwell, assistant to general manager at Syracuse, N. Y. Irving A. Olp, trainmaster at Buffalo, succeeds Mr. Maxwell, and Walter A. Jackson, assistant trainmaster at Springfield, Ohio, succeeds Mr. Olp.

The latest in Diesel Locomotives

is protected by NUGENT FILTERS

The newest thing to hit the rails in diesel locomotives is Fairbanks, Morse's new 4800 H.P. two unit passenger locomotive. This locomotive is the prototype of Fairbanks, Morse's "Consolidation Line" which will be offered in horsepower ratings from 1600 H.P. to at least 9600 H.P. in single locomotives. Outstanding features are high horsepower per foot of length and increased weight on drivers despite a reduction in over all weight.

In a locomotive of this type when so much depends on efficient day-in and day-out performance, it is natural that Nugent lube oil filters were selected to help protect the vital working parts of the 2400 H.P. engines.

Nugent pressure type filters are your best assurance of clean oil for all types of diesel power. By actual test they get out 99.8% of the dirt. Size for size they offer larger filtering area, and uniform dirt loading provides maximum efficiency and maximum life. Recharges are the inexpensive "Throway" replaceable type.

To get the long, dependable life your diesels were built to give, equip them with Nugent Filters. This is an investment that will come back to you many times over. Available for diesel engines from 1 to 384,000 H.P. in single containers.

Write today for descriptive literature.

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OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

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DTA Appointment

Administrator James K. Knudson of the Defense Transport Administration recently announced the appointment of Mr. G. H. Minchin of Chicago, Illinois, as director of DTA's Railroad Division.

Minchin began his career with the Atchison, Topeka & Santa Fe Railway Company in 1902, and has been continuously employed to the present time in its operating department. He is presently senior vice president of that railroad in charge of the operating department, president of the Chicago Produce Terminal, and president of the Illinois Northern Railway.

"Cat" Promotions

Promotions and organizational changes have recently been announced by Caterpillar Tractor Co.

The research department has announced the promotion of Robert C. Brown to the post of assistant director of research, handling engine development work.

Norman K. Alberts, former service representative in Albany, N. Y., has been appointed assistant export service manager. He has been with the company for the past five years. Nicholas Kent, service representative in Jacksonville, Fla. for the past four years, has been named service manager of the Plains division.

Cummins Changes

Two experienced Cummins sales executives were recently appointed as direct factory representatives to governmental agencies.

C. B. Foster will head a new department of the sales division as manager-contract sales.

John W. Post has been named regional manager of the newly created Washington, D. C. region.

Company officials indicate that this move will result in closer co-ordination of the factory's activities to the accelerating demand for Cummins diesels by the nation's mobilization program.

(*Organizational News Continued on Page* 145)

Rotary Geared Pumps WITH INTEGRAL FLANGE MOUNTINGS

Here's a line of pumps that simplifies installation problems in diesel lubrication or fuel transfer. Brown & Sharpe Rotary Geared Pumps Nos. 1, 2, 3, 4, 1S, 2S, and 3S can be furnished with flange mountings for practically any mounting condition. They are especially useful where it is desired that the pump be an integral part of the engine or machine. Write for complete catalog or details on how these pumps may be used to solve your special problem. Brown & Sharpe Mfg. Co., Providence 1, R.I., U.S.A.

We urge buying through the Distributor

BROWN & SHARPE

TAC does what no other tool can do!
AT LAST! AN OPEN-END RATCHET WRENCH — the world's first true universal wrench. A patented design for connections on tubing, rods, piping, conduit, studs, etc. Sixty-four socket sizes from ⅜" to 4". Smallest effective ratcheting arc yet — 5° to 7½°. TAC will also do every job any ordinary ratchet wrench will do: one TAC set replaces literally dozens of single-purpose hand tools.
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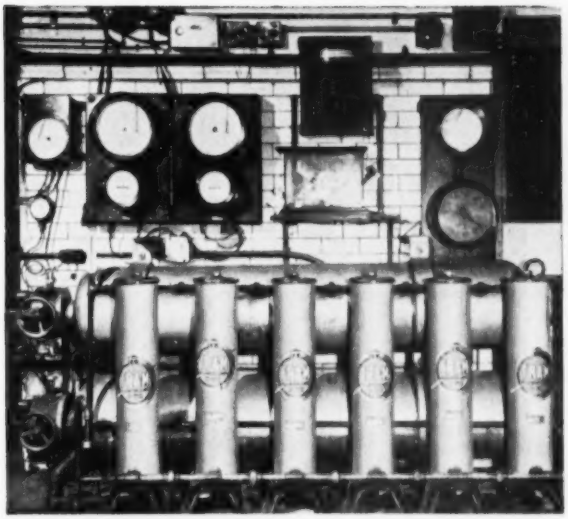

These six Fram Filters serve 840 h. p. Fried Krupp Diesel at large eastern university. This Diesel drives a 600 kw. Crocker-Wheeler generator.

University Cuts Maintenance Costs of Diesel Power Plant with FRAM Filters

Four Fram Filter installations filter dirt, grime, sludge and carbon from lubricating oil of 545 h.p., 630 h.p., 840 h.p. Fried Krupps and a 448 h.p. Baldwin in power house of large eastern university. Engineers consider Fram Filters the best . . . definitely a money-saver. Absolutely no maintenance except changing cartridges.

FRAM Filcron Filters Do the Job Better!

- *Remove solid and abrasive contaminants 1 micron (.000039") and larger*
- *Minimize Engine Wear*
- *Reduce Engine "Down-time"*
- *Extend Engine Life*
- *Lower Operating Costs*

No matter what your Diesel oil filtering problem—either fuel or lube—Fram can help you conquer it. Write for full information today to FRAM CORPORATION, Providence 16, R. I. *In Canada:* J. C. Adams Co., Ltd., Toronto, Ontario.

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THE MODERN OIL FILTER

THOMAS
Flexible ALL METAL
COUPLINGS
FOR POWER TRANSMISSION
REQUIRE NO MAINTENANCE

Patented Flexible Disc Rings of special steel transmit the power and provide for misalignment and end float.

Thomas Couplings have a wide range of speeds, horsepower and shaft sizes:
½ to 40,000 HP
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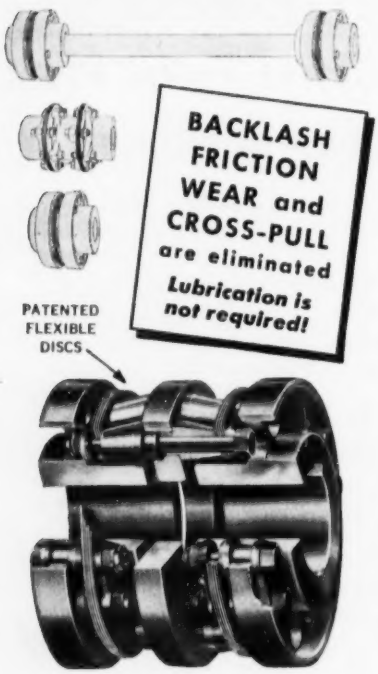
Specialists on Couplings for more than 30 years



THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT.
NO MAINTENANCE PROBLEMS.
ALL PARTS ARE SOLIDLY BOLTED TOGETHER.

Write for the latest reprint of our Engineering Catalog.

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA

Diesels in the Oil Industry

(Continued from page 77)

pipe line rights of way, in the construction of access roads, in clearing rig sites, in scooping out slush pits, and in skidding derricks and other equipment.

Petroleum men have found that diesel engines are more suitable than any other form of motive power for pipe line stations located in remote spots where there is no electric power and where water is scarce. The supercharged dual fuel diesel engines are making headway with pipe line companies because of their ability to produce low-cost power for pumping stations. For this reason four of the seven stations of the 1000 mile Mid-Valley Pipe Line are diesel powered.

The newly constructed Creole Petroleum Corporation's 143 mile pipe line from Ule, via Dabajino, to Amuay, Venezuela, is powered with 14 Cooper Bessemer diesels at its three stations.

The 1127 mile pipe line of the Interprovincial Pipe Line Company of Canada and the Lakehead Pipe Line of the United States, which is now in the process of construction between Edmonton, Alberta and Superior, Wisconsin will use diesel engines. At the Edmonton and Kerrobert stations there will be four dual fuel diesel units of 1030 hp. each; at the Regina and Cromer stations there will be three diesel units of 810 hp. each; at the Gretina station there will be three diesel units of 540 hp. each; and at the Clearwater station there will be two diesel units of 810 hp. each.

The Great Lakes Pipe Line Company, which operates 4500 miles of pipe line from Oklahoma in the South to Minnesota and North Dakota in the north, operates diesel engines in its pumping stations with a total capacity of 60,000 hp.

Within the past two years the Union Oil Company's tanker loading facilities at Avila, California replaced its two steam turbines with three powerful Enterprise diesel engines which provide the power for pumps which have a total rated capacity of 20,000 barrels an hour.

Most of the drilling contractors, oil companies and pipe line companies follow the periodic preventive maintenance schedules as outlined by the manufacturers of the engines. And to aid diesel engine users in their efforts to properly service their equipment a number of the engine manufacturers have established repair and maintenance service shops in strategically located points in the major oil producing areas of the United States.

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We have a number of alert young men who have completed intensive training in Diesel Mechanics. They learned their trades thoroughly by working on actual equipment under personal, expert supervision. If you need a trained man, we invite you to write for an outline of our course, and for a prospectus of the graduate. No fees, of course. Address:

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For Additional Information
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AUTOMOTIVE PRODUCTS, INC.
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New Baldwin Board Members

At a meeting of the board of directors of Baldwin-Lima-Hamilton Corporation held recently, McClure Kelley and Ralph K. Stiles were elected to membership on the board. Messrs. Kelley and Stiles are president and executive vice-president respectively of Austin-Western Company, which became a wholly-owned subsidiary of Baldwin-Lima-Hamilton Corp.

Link-Belt Promotion

Link-Belt Company recently announced that Mr. Harry G. Andersen, formerly district sales engineer at Milwaukee, Wis., has been appointed district manager at Birmingham, Alabama.

Mr. Andersen was educated at Northwestern University, Illinois Institute of Technology, and Wisconsin University. He started with Link Belt in 1937 at the Pershing Road plant in Chicago, where he served in various capacities in the engineering department and Chicago district sales. He was transferred to Milwaukee in 1943.

Mr. Andersen succeeds Mr. J. T. Bell, Jr., who has been called back into the service of the U. S. Army, Corps of Engineers.

Westinghouse Makes Washington Appointment

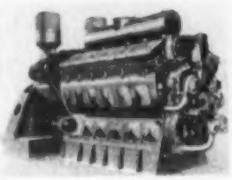
Henry R. Michel has recently been appointed assistant to Andrew H. Phelps, vice-president in charge of purchases and traffic for the Westinghouse Electric Corporation, Pittsburgh, Pa. In his new position, Mr. Michel will be assigned to the Washington, D. C. office, with responsibility for all matters pertaining to purchasing as it is affected by governmental regulations.

A native of Bozeman, Montana, he is a graduate of Montana State College. He first joined the company in the time study and rate department of the East Pittsburgh Works. He was later transferred to the storekeeping and purchasing department and was named assistant purchasing agent in 1927, and in 1938 became purchasing agent for the works. In 1943, Mr. Michel was presented with his company's highest honor—the Westinghouse Order of Merit.

DIESEL ELECTRIC POWER

for IMMEDIATE SHIPMENT

Unit Capacities 100 to 1875 Kva A.C. 50-60 Cycles Various Voltages



Write or wire today for bulletins and complete information regarding these fine fully guaranteed, low cost DIESEL ENGINE GENERATING UNITS. Visit our plants at Sausalito (S. F.), California, and Jersey City, N. J., and see units in operation on our test stand.

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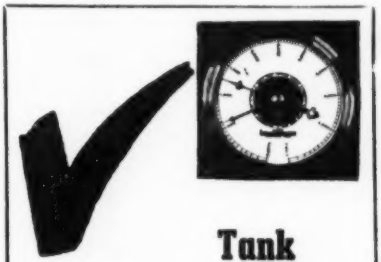

Tank Contents At A Glance

With Liquidometer remote reading fuel storage tank gauges you can check quickly and accurately oil deliveries, consumption and amount on hand. No Diesel plant is complete without one. Liquidometer or Levelometer models are available for tanks of any capacity.

Write for complete information

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Zallea Expansion Joint News

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Expansion Joint of the Month

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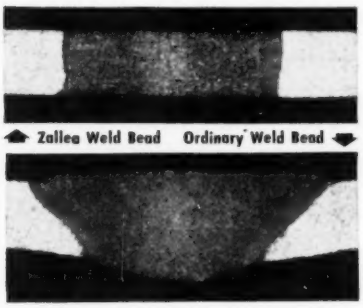

analyzing the many known welding processes, adopted an exclusive variation of the Heliarc process and added a grain refining procedure to the finished weld. In hundreds of brutal flexing tests, not one failure occurred within 30 degrees of the weld line! More important was the fact that these bellows lasted 4 to 8 times longer than bellows having a shielded arc welding bead. Note the exclusive Zallea controlled welding technique as compared to the welding procedure used in other flexible connectors. When you want the best in flexible connectors, always specify Zallea...you'll find it pays!

The supply is going fast . . . send TODAY for your copy of Catalog 47, a text book and valuable reference source on all Zallea Expansion Joints.

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THESE 6 "REASONS WHY" ...offer you the best in Flexible Connectors

- Annular corrugations permit greatest flexibility . . . maximum durability . . . longest service life.
- Torsional strains are eliminated action of parallel form of corrugation.
- Great axial as well as lateral movement.
- Flexibility enables bending to a minimum radius of as little as 1½ times the diameter.
- No seams or joints to open.
- No packing required . . . permanently gas-tight.

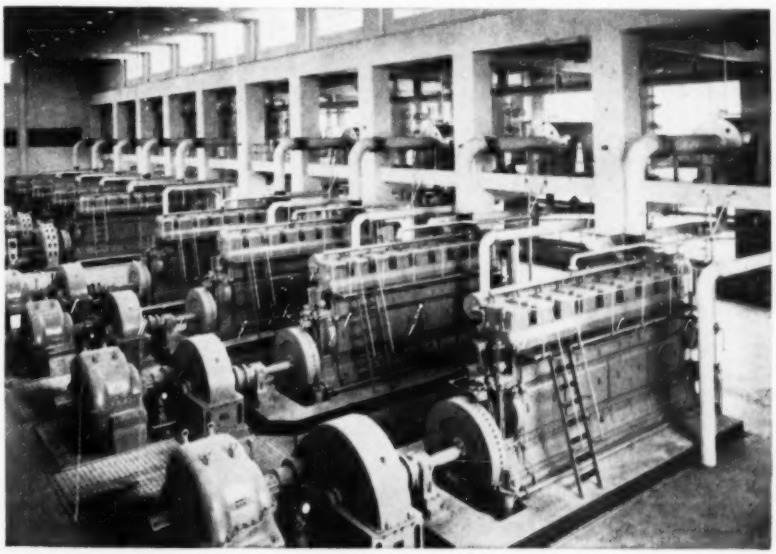
Zallea Stainless Steel Flexible Connectors are available in diameters from 4" to 72" with flanged or welding ends or a combination of both to handle exhaust temperatures up to 1600° F.

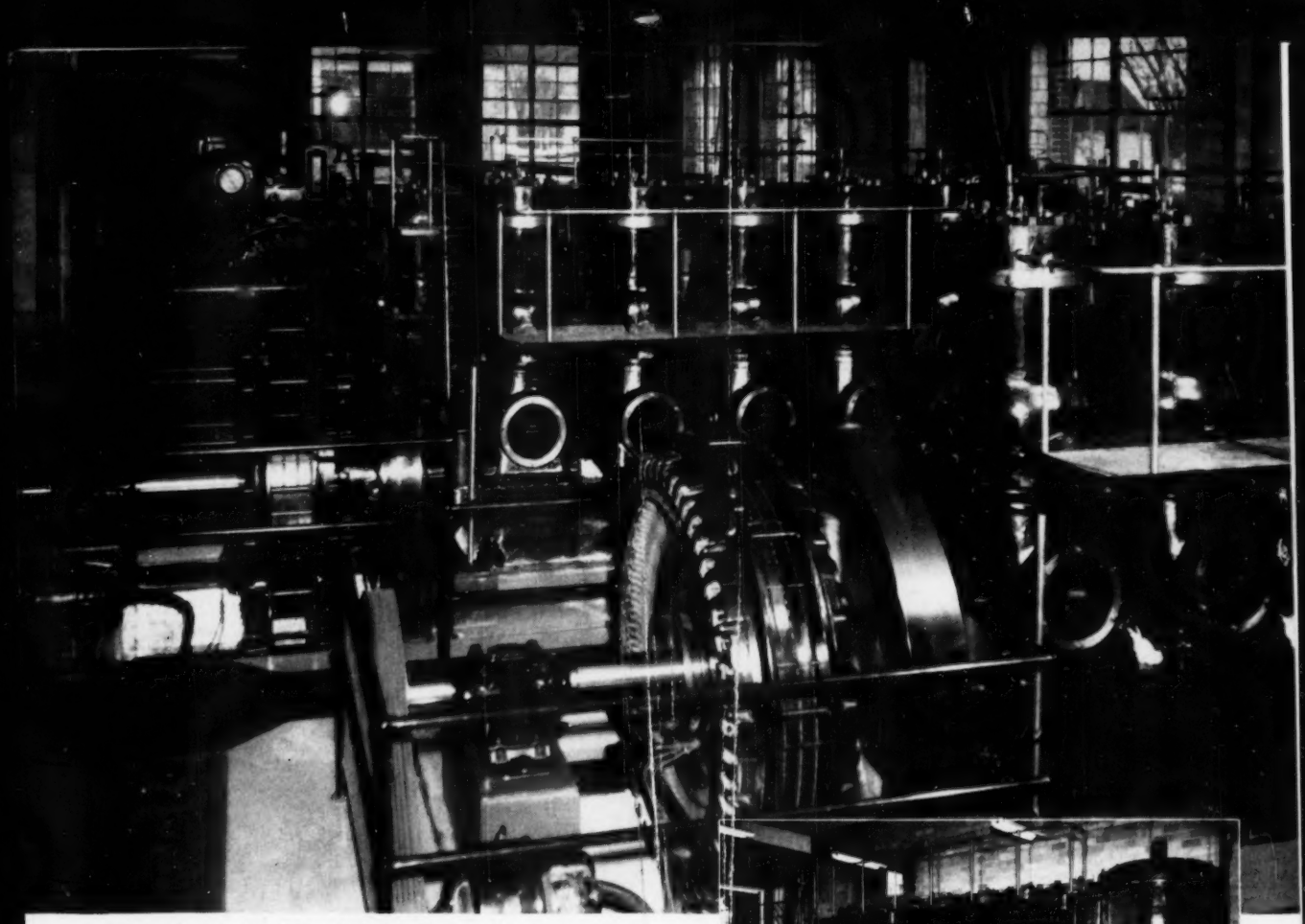
West Coast Waste Disposal Plant Uses Zallea Flexible Connectors

When plant equipment was considered for one of California's largest waste disposal plants, Zallea Stainless Steel Flexible Connectors were chosen for service on the Diesel exhaust lines. Shown here are 9 16" Zallea Stainless Steel Flexible Connectors at work helping to keep this important utility operating at peak efficiency.

Built For Long Service Life

In every Zallea Stainless Steel Flexible Connector you'll find simplified construction. Flexibility has been achieved at no sacrifice of durability . . . maintenance is eliminated because there's no packing required . . . no seams or joints to open. And, Zallea Flexible Connectors, engineered with annular corrugations, eliminate torsional strains so common to spiral or helical types of connectors. Check the features above to see why Zallea Stainless Steel Flexible Connectors are selected *first* by engineers . . . and how they can do the best job for you.





Above: Interior view of Municipal Light Plant, Madelia, Minnesota.

Right: T. C. Splinter, Superintendent (at right), checks performance of big diesel while S. C. Field of Standard Oil's Mankato office looks on.

Ailing diesels get clean bill of health

As power demands grew, so did trouble for the Municipal Light Plant of Madelia, Minnesota. Carbon formed rapidly in the plant's three diesel engines. Ports required cleaning every two to three weeks. Diesels had to be shut down frequently to free stuck rings and remove varnish from cylinder walls.

T. C. Splinter, plant superintendent, put the problem to a Standard Oil lubrication specialist. The lubrication specialist pointed out that the straight mineral oil used in the engines was not able to stand up under the severe conditions of operation. He recommended a switch to STANDARD HD Diesel Oil.

This heavy-duty lubricant made a clean sweep of the troubles. In four years of hard service, STANDARD HD has kept engines clean and rings free. Port carbon has been reduced to a minimum. Engines are now operated up to 8,800 hours before they are inspected or cleaned. Maintenance costs have been trimmed 30% to 40%.

STANDARD HD
TRADE MARK
Diesel Oil

A 1400-hp diesel engine was added to the plant in 1948. This makes a total of 2,840 diesel horsepower now protected by STANDARD HD for this plant.

The experience of T. C. Splinter indicates how you can reduce maintenance costs with STANDARD HD Diesel Oil. A Standard Oil lubrication specialist will be glad to help you obtain maximum benefits from this superior diesel oil.

Arrange for his visit, now, by phoning your nearby Standard Oil Company (Indiana) office . . . or write: Standard Oil Company (Indiana), 910 So. Michigan Ave., Chicago 80, Illinois.

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